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# POWER

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Index to Advertisers, 52.

This Trademark

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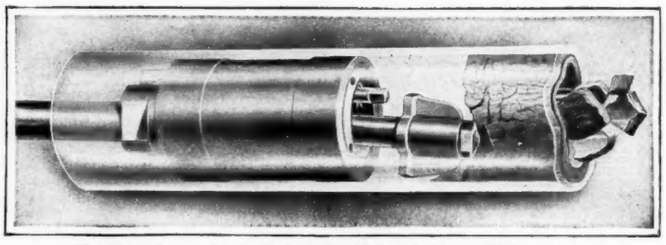

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The Delaware Leather Co., of Wilmington, Del., were compound users—that to some would have been sufficient grounds for believing the boilers *clean*. But they were willing to investigate our claim that they *did* have scale and that we *could* save them money.

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| | | |
|---|---|---|
| Average coal consumption before using Dean, | 12.90 | tons per week. |
| " " " after " " | 11.31 | " " " |
| *Gross Saving* - - - - | 1.59 | " " " |
| Estimate of allowance for extra work done by engine, and for cold weather, | .75 | " " " |
| *Net saving* - - - - | .84 | " " " |

Coal cost them, $3.40 per ton; hence, they make a *net saving of* $2.86 *per week.*

This report is all the more significant because of the small amount of scale removed—*only* 202 *pounds*.

Mighty few boiler inspectors would have detected its presence—mighty few concerns suspected it was costing $2.86 per week.

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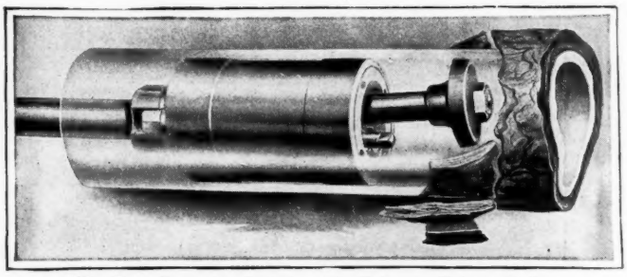

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# LUNKENHEIMER "RENEWO" VALVES

Let the purchase of your valves be governed by **"QUALITY;"** carefully consider **durability and practicability;** compare the **"Renewo"** with other makes of valves, and we feel satisfied as to your choice.

When you buy a **Lunkenheimer "Renewo" Valve,** you get a valve as perfect as modern science and ingenuity can produce, coupled with the careful selection of the best of only new material and the employment of men skilled in the manufacture of engineering appliances.

The **"Renewo"** is a valve of **exceptional durability,** made so not only because of the **high grade material used,** but also owing to the **scientific construction of the seat and disc,** which parts are subjected to the greatest wear. Their peculiar construction **greatly minimizes the wear on the seating faces** (caused by the velocity of steam flowing through the valve) and **positively prevents any scale or dirt lodging on these faces** when the disc is about to seat, thereby preventing injury to them.

To further insure durability, **both seat and disc are made of a mo... ble nickel alloy,** a material ... for the hard service to whi... these parts are subjected.

A slight wear on the seating faces can be easily remedied by **regrinding**—a process that can be quickly accomplished without detaching the valve, and one that will make the valve as tight and as serviceable as when first installed.

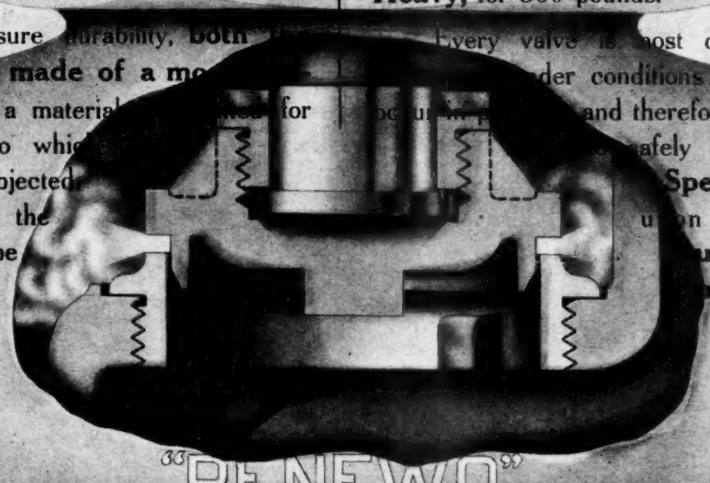
The last but most important feature of **Lunkenheimer "Renewo" Valves,** as regards durability, is the fact that **all parts subjected to wear are renewable,** and this particularly includes the seat and disc, and when renewing any of these parts it is not necessary to break the pipe connections.

The body and trimmings, with the exception of the seat and disc, are made of the highest grade of bronze composition, containing a large percentage of copper and tin, and to insure a uniform mixture, **only new material** is used.

Large and unobstructed areas through the body; a non-corrosive union connection between the body and hub, and a stuffing-box which can be packed under pressure, are other features of importance.

**Lunkenheimer "Renewo" Valves** are made in sizes ranging from ¼ to 3 inches, inclusive, and in two weights; **Medium,** for working pressure up to 200 pounds, and **Extra Heavy,** for 300 pounds.

Every valve is most carefully examined ... der conditions more severe than ... and therefore we are enabled ... safely guarantee its use. **Specify and insist** upon securing genuine **Lunkenheimer make.** Do not accept substitutes —they are never as good as the geniune.

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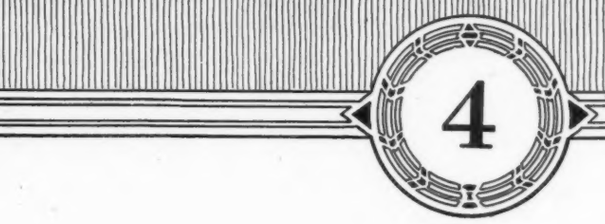


# The Purpose Of The Boiler Is To Make Steam

You know that; every man who has anything to do with boilers knows that—

Likewise that a boiler can't make as much steam as it should make, with scale on the heating surface.

Now, then—is it logical to allow scale to form and then scrape it out—

Losing boiler efficiency every hour that scale is allowed to remain in the boilers?

Or isn't it better to *prevent* the scale from forming at all?

Granted that the cost of the necessary Dearborn Treatment, which prevents scale formation, may be a little greater than the cost of a scraper or hammer—

You can readily see, however, that the long run cost of the treatment is *far less* than that of any other method.

Because the Dearborn Treatment saves coal, saves boiler wear and tear, saves trouble and eliminates shut downs and night work.

In other words, Dearborn Treatment earns its cost over and over again. It's an investment that pays profits.

Whereas mechanical methods are expense producers—the first cost is an expense, and every day that scale exists in the boiler the expense increases, more coal is required, and boiler capacity is decreased.

The Dearborn way is the Right way—send sample of your boiler feed water and we'll tell you how to get rid of your scale troubles at least expense.

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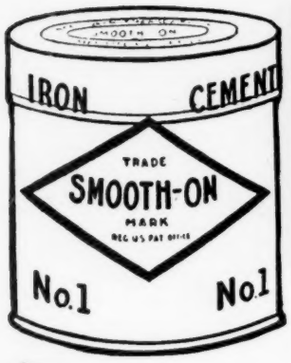


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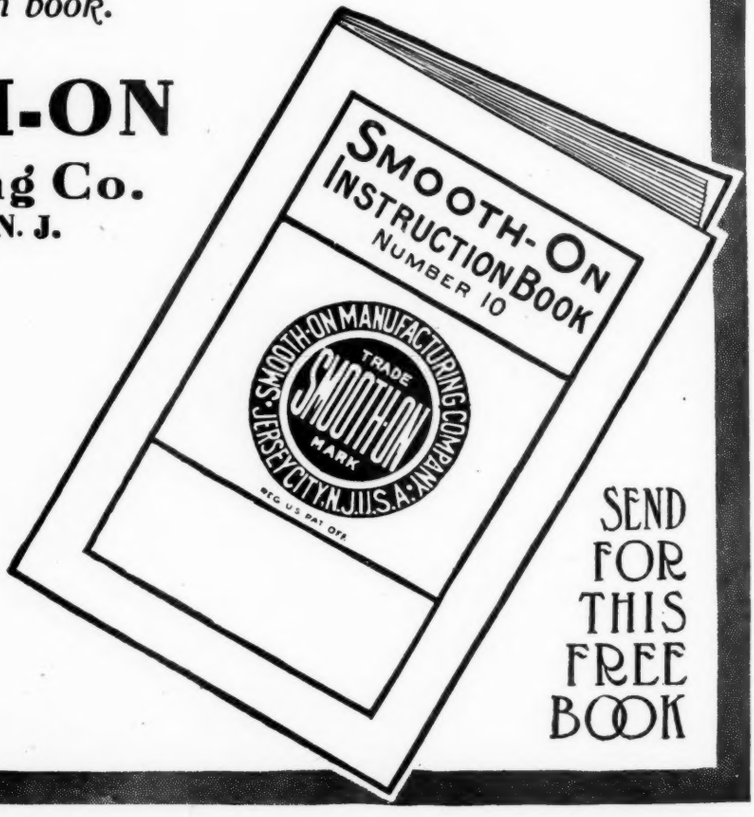


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# POWER

Vol. 35 NEW YORK, JUNE 25, 1912 No. 26


## One as Useful as the Other

Looks like this turbine is running itself while Billy Sleeper is in the Dreamland Pool Parlor. A cigar sign could just as well take his place.

Because a turbine calls for less physical effort to keep it going than a reciprocating engine is no reason why the engineer should sleep on the job.

About the only rosy dreams that come true in a power plant are hoped-for reward and advancement in consequence of strict and constant attention to duty.

The wooden Indian is fast disappearing from in front of the tobacco tepees and the somnolent engineer disappears even faster when the plant owner gets wise to his habits.

# Power Plant of Sears, Roebuck & Co.

By C. A. Tupper

**A showy Corliss-engine non-condensing plant in which the exhaust steam is used for heating.**

**Coal handling facilities and equipment for fire protection are unusually complete.**

Sears, Roebuck & Co., the mail-order house, occupying a large group of buildings on the outskirts of Chicago, have one of the most modern and complete power plants in that city, under the direction of A. F. Wright, chief engineer. The electric generating plant, centrally located, covers 30,000 sq.ft. It is entirely fireproof, being constructed of steel, concrete and brick, and was specially designed to accommodate the machinery installed. The engines, boilers, generators, etc., are on the ground floor, while the auxiliary apparatus, piping, etc., are in the basement. Longitudinally the building is divided into boiler and engine rooms by a wall extending its full height. A 15-ton crane travels the length of the engine room.

Coal is received on a spur along the south side of the power house, equipped with a 100-ton standard Fairbanks-Morse track scale. That for immediate use in the power plant is dumped into a reinforced-concrete hopper over the crushing rolls, and after leaving these is transported by a steel belt conveyor to a bucket conveyor serving the bunkers. At the south side of the power house are concrete storage bins of 2200 tons capacity. In these the coal can be submerged in water and kept indefinitely. Each bin can be drained to the sewer when coal is to be removed. The coal is handled to and from these bins by an electric crane with a 3-yd. clamshell bucket.

At the bunker loft the coal from the bucket elevator is taken by a portable dumper and distributed to bins, each holding 100 long tons. From these, spouts lead to the stokers, which have moving chain grates driven by an 8x8-in. Wachs engine. Two furnaces burn refuse from the company's various departments. This refuse is chuted to the basement of each building and taken by trucks, through tunnels, to two Williams pulverizers. After being ground it is blown through ducts by a fan to a cyclone on the boiler-house roof and falls by gravity to the furnaces. The same bucket conveyor that handles the coal takes the ashes to a 50-ton bunker, from the bottom of which they are drawn off to a steel belt conveyor discharging to railroad cars outside.

Eight Aultman & Taylor water-tube boilers, with superheaters, are arranged in batteries of two each in a single row. The aggregate normal rating is 4000 hp. One man operates this part of the plant. Draft is furnished by a 225x14-ft. brick stack, on a concrete foundation 60 ft. deep. Feed water from the city mains and returns from the heating system discharge into an open heater, from which it is delivered to the boilers by two Fairbanks-Morse 10x16x8.5x18-in. compound duplex pumps equipped with Fisher governors.

Steam at 150 lb. pressure and 70 deg. F. superheat passes through 6-in. bends to a 16-in. loop header to supply any engine from either side of the boiler plant.

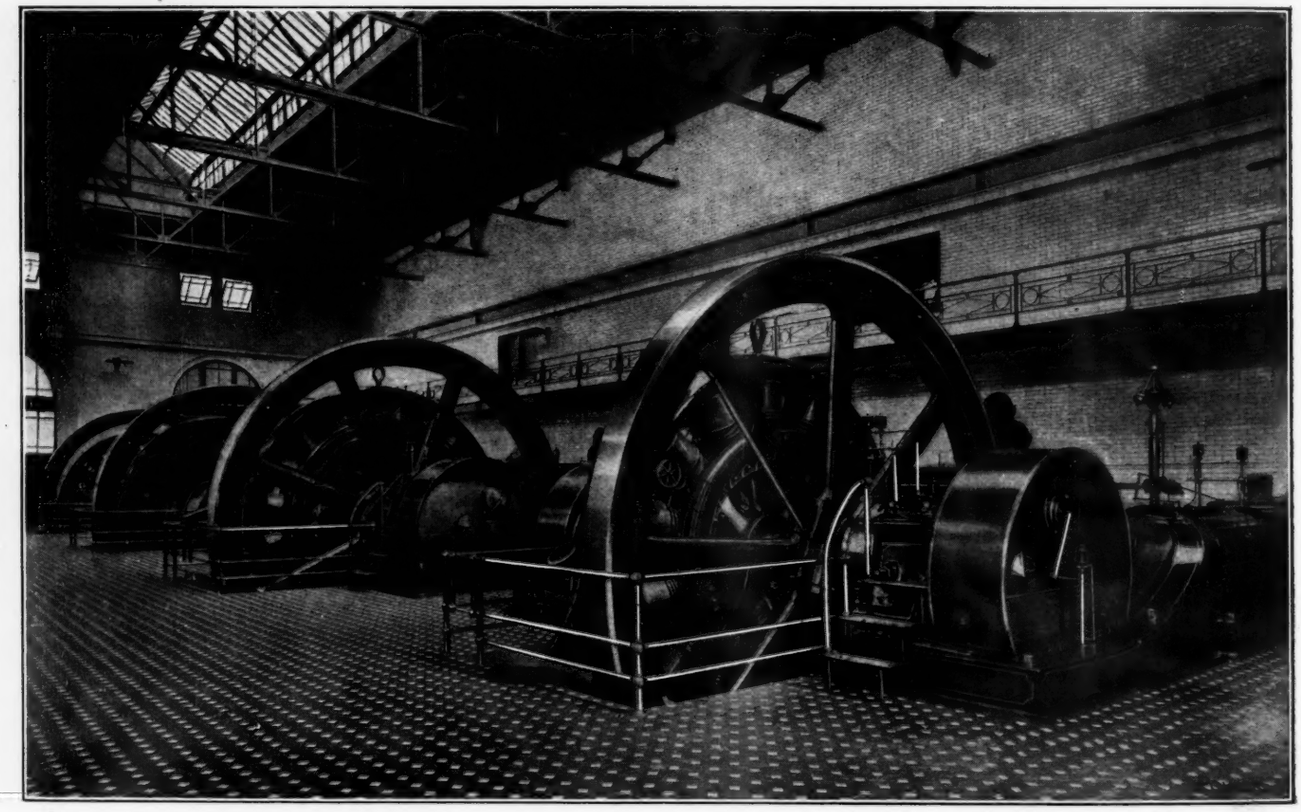


FIG. 1. ENGINE ROOM OF SEARS-ROEBUCK POWER PLANT

In the engine room are four generating sets. Three are 24 and 50 by 48-in. horizontal cross-compound Corliss engines making 85 r.p.m., directly connected to 750-kw. continuous-current generators. The fourth is a 20 and 40 by 42-in. engine driving a 500-kw. generator at 90 r.p.m. These units were built by the Allis-Chalmers Co. Each engine has a Richardson-Phoenix sight-feed oil pump. All of the lubricating oil is supplied from an

elevated tank, to which it is pumped back after filtering.

Light loads at night and on Sundays are carried by two Allis-Chalmers 220-volt generators driven by Ames engines, one of 50 kw. by a 12x12-in. engine and one of 100 kw. by a 14x14-in. engine. All six generators are compound wound.

The engines run noncondensing. Their exhaust passes to a 36-in. collector, with two Austin oil separators and thence to an expansion chamber where live steam can be added. It then goes into the heating system, or to the atmosphere.

also very extensive, including 44 inclosed-arc, 19,700 incandescnt, 4200 Nernst, 12 Cooper Hewitt and 1913 tungsten lamps. The latter are used mostly with the indirect system of lighting in the administration building.

While radiators are installed, particularly in the more exposed parts, most of the heating is by a hot-blast system, which also ventilates and in summer circulates cold air. There are 33 motor-driven fans. The air supply is taken through filter chambers. Two 16 and 22 by 20-in. Marsh vacuum pumps in the

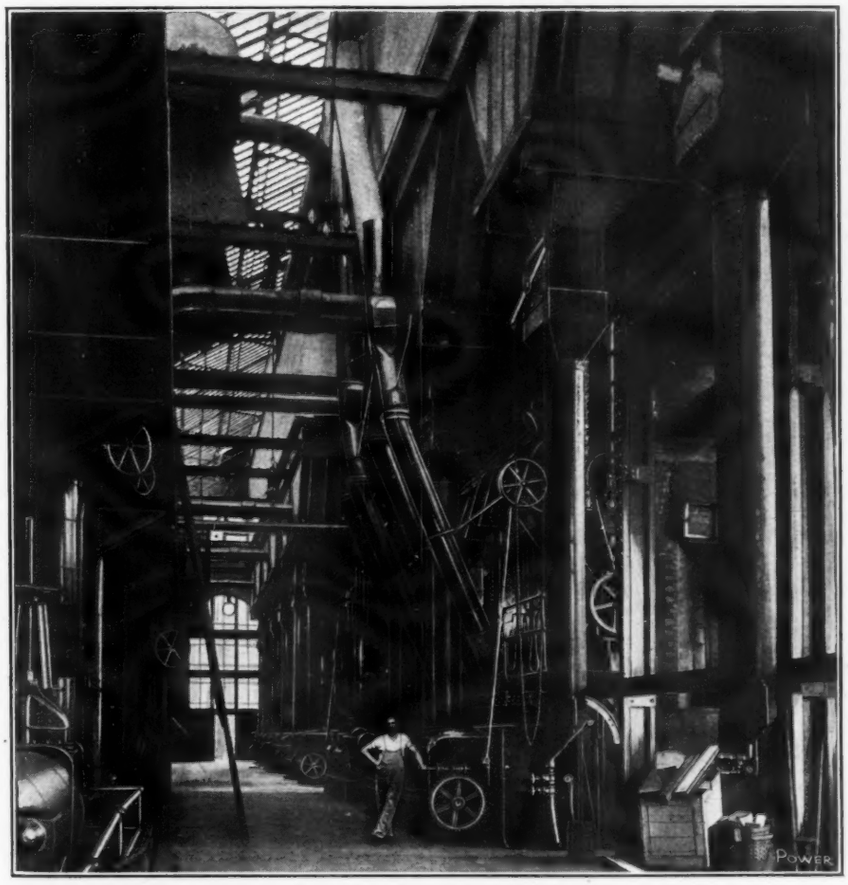



FIG. 2. BOILER PLANT HAVING NORMAL RATING OF 4000 HP.

The current mains lead through conduits under the floor to a 20-panel switchboard at one side of the room, which is of standard angle-iron frame construction, with white Tennessee marble front. Each panel has the usual controlling, regulating and current-indicating apparatus, including integrating and recording instruments. The busbar system is in duplicate, each part interchangeable with the other.

Current is distributed through cables laid in tunnels (which also contain the pipes carrying water, steam for heating, etc.) to the different buildings. In these, including the power plant itself, and on conveyors, elevators, etc., outside, are nearly 500 motors in sizes from ½ to 150 hp. They are used for a great variety of purposes, including the operation of a printing plant. The lighting system is

sub-basement are on the heating system, discharging into an open tank on the basement floor; from here the return water is delivered to the heater in the boiler room by two 8 and 12 by 12-in. Marsh steam pumps.

In the engine-room basement is a 30-ton Carbondale live-steam refrigerating machine, used to make ice for the restaurants, water coolers, etc., and also a motor-driven triplex house pump. The filtered drinking water is handled by two 10 and 7½ by 12-in. duplex steam pumps.

Three two-stage Laidlaw-Dunn-Gordon air compressors in the engine room, one of 300, one of 400 and one of 1000 cu.ft. per minute capacity at 100 lb. pressure, the latter a cross-compound Corliss, supply air for cleaning, pneumatic hoists and pumping water from two deep wells.

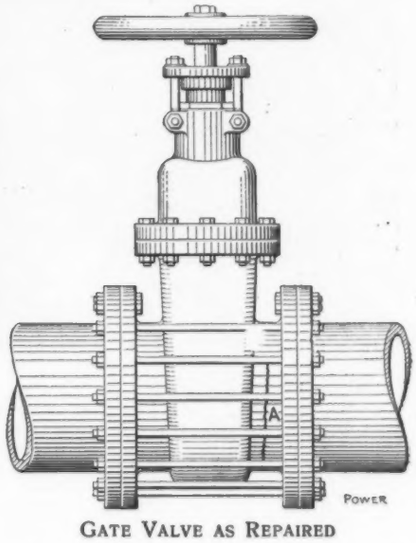
The pneumatic-tube system is operated by three Connersville blowers, each of 118 cu.ft. per revolution capacity, independently belted to 100-hp. motors. There are nine miles of 4-in. tubing in this system.

In the engine room are two 8x12x8x18-in. compound duplex steam house pumps, one 18x22½x22½x5⅛x24-in. compound Corliss, one 20x31x9x24-in. and one 14x20x5¼x18-in. compound duplex elevator pumps, and three 18x10x12-in. duplex fire pumps, each having a capacity of 1000 gal. per minute. The fire pumps are controlled by Foster piston-actuated governors, and are in constant operation, maintaining 125 lb. pressure.

The fire-protection equipment is very complete and under the control of a supervisory signal system which automatically indicates the condition of the apparatus at each point. Any alarms turned in are registered in the fire marshal's office, in which is installed a very elaborate switchboard for this purpose. This system and the automatic telephone system and signal bells are operated with 20-volt current furnished by two motor-generators in the engine room.

## Gate Valve Repair

A large gate valve in the suction pipe of a 3,000,000-gallon pumping engine cracked, as shown by the line *A* in the accompanying illustration.




GATE VALVE AS REPAIRED

Removing such a valve was not only a laborious job, but an expensive one as well. There were sixteen ¾-inch bolts holding the flanges of the valve and pipe together. Seven of these bolts were removed and through bolts substituted, passing through both flanges of the valve and the two pipe flanges, as indicated. When the bolt nuts were tightened the metal on both sides of the crack was drawn together and the leak gave no further trouble.

This fracture was caused by shutting down the pump too quickly which created an excessive pressure in the suction pipe.

# Tom Hunter, Hoisting Engineer

By Warren O. Rogers

**Hunter explains the use and operation of the Vulcan Corliss hoisting engine for mine work, and tells how the governor is cut out of control.**

**He also tells why hoisting engines are not operated condensing and then suggests how a condenser could be used.**

The next day, after viewing the operation of the safety stop for hoisting engines, I passed one of the manufacturing plants of the town and the "click, click" of the engine attracted my attention as the sound escaped through a partly open window of the engine room.

Being curious to see what type of engine this might be, I entered the engine room and found a Corliss making about 95 r.p.m.; the rim speed on the flywheel was close to a mile a minute. After a pleasant visit with the engineer I went on my way, but I could not help wondering why I had not seen a Corliss hoisting engine at the numerous mines I had visited.

### Corliss Hoisting Engine

If a Corliss engine is economical in one plant, I reasoned, it should be a money saver in another. The next morning after breakfast I met Hunter and asked him how it was that we had seen no Corliss hoisting engine, and if there were none in use.

"Why, there are Corliss hoisting engines—quite a few of them. There are several of them in nearby towns. Suppose we take a run over and see one"; and we did.

This engine proved to be a 30x40-in. first-motion, Corliss equipped with a 10 to 13-ft. double conical drum, a steam reverse, a steam brake and a dial indicator.

"This," said Hunter, "is a Vulcan Corliss hoisting engine. The real distinction between it and other Corliss engines is that instead of a rocker-arm for operating the steam valves, as in ordinary practice, a link is attached to a rocker-arm so that the engine's rotation can be reversed. It is equipped with the regular Corliss valve-gear in other respects. The steam and exhaust valves are operated by the same rocker-arm and link. Corliss engines are becoming more numerous about the mines, especially at the breakers, and some of them are of the reversible type."

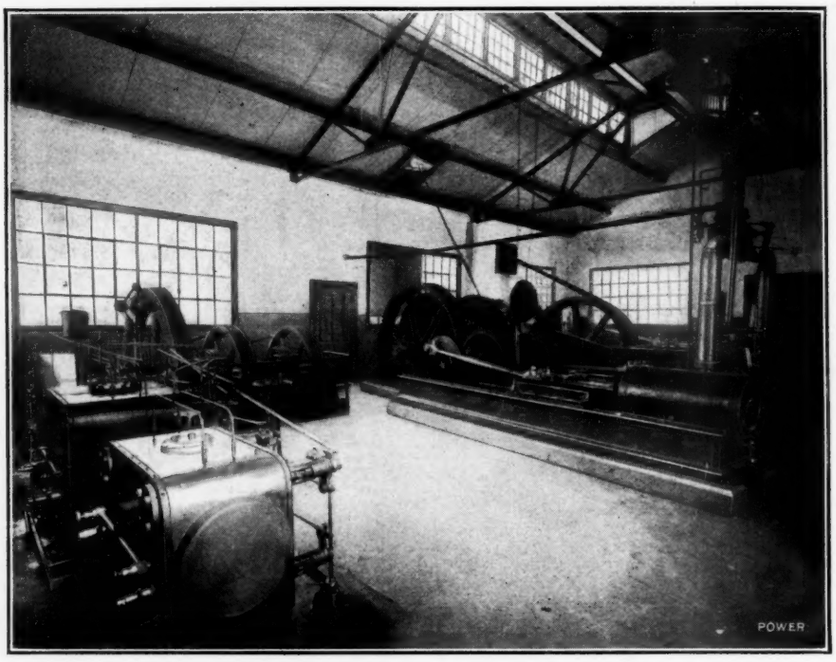



Fig. 1. Corliss Engines Operating Colliery Breaker

"I don't see why a reversible engine is wanted to run a coal-breaker. Of course, there is no reason why an economical engine should not be of as much value to a coal company, for what coal it does not burn it can sell."

"You remember this engine room, don't you?" replied Hunter, as he picked up the photograph shown in Fig. 1. "We found a tandem Corliss engine driving the breaker shakers, a geared hoisting engine for drawing the loaded mine cars up into the breaker. The third engine, which was a link Corliss and could be reversed, was used to run the breaker rolls and conveyors."

"Why should there be any call for reversing this engine?" I asked, for, to my in-experienced mind, this was all straight work and called for no reversing of the machinery.

"Frequently the men find it convenient to reverse the rotation of the rolls or conveyor when they become clogged, as they do sometimes. Then the reversing engine comes in handy."

"I see. Well, go on with your sermon."

Hunter grinned and took up the thread of his talk.

"The governor of the Corliss hoisting engine is so arranged that it can be thrown out of adjustment and a partial movement of the throttle valve throws the cutoff motion into gear. This allows the engineer to start the loaded cage at the bottom of the shaft with steam admitted at nearly full stroke of the engine. Then, after the engine has made two or three revolutions, the throttle lever is thrown over to its full travel and the cutoff becomes operative; that is, the steam valve closes when the latch blocks are disengaged, the same as in the case of an ordinary Corliss engine."

"This engine seems to run easily and at a good speed," I remarked, as the engineer started to hoist.

"There is no reason why it shouldn't," replied Hunter, as he wiped his hands with a piece of colored waste. "The regular rate of hoisting with this engine is 105 mine cars per hour and a record of 925 cars has been made in eight hours, I am told."

### Hunter Explains the Corliss Link Motion

As the engine was in operation most of the time, Hunter suggested that I visit the Vulcan works, where I could get a better idea of the construction of the engine and also obtain photographs of the link and valve-gear, which I did. When we returned to the hotel, I invited Hunter to my room, as I wanted further information regarding the operation of the valve-gear of which I had also obtained photographs, and Hunter readily consented to enter into an explanation. I often wonder how he had the patience to answer all of my questions.

### Governor and Link

The first photograph he took up is shown in Fig. 2. "This," said he, as he dropped comfortably into a rocking-chair, "shows the valve-gear, governor and link arrangement. The rods connected with the steam and exhaust valves are connected to a rocker-arm which receives its motion from the link block as it is actuated back and forth by the link and

eccentric rods. By changing the position of the link, the travel of the link block is made either longer or shorter, which reacts back to the valve-gear and controls the opening of the valves when the governor is not controlling the point of cutoff. The one governor controls the valve-gear of both cylinders by means of a governing rod running from one engine to the other.

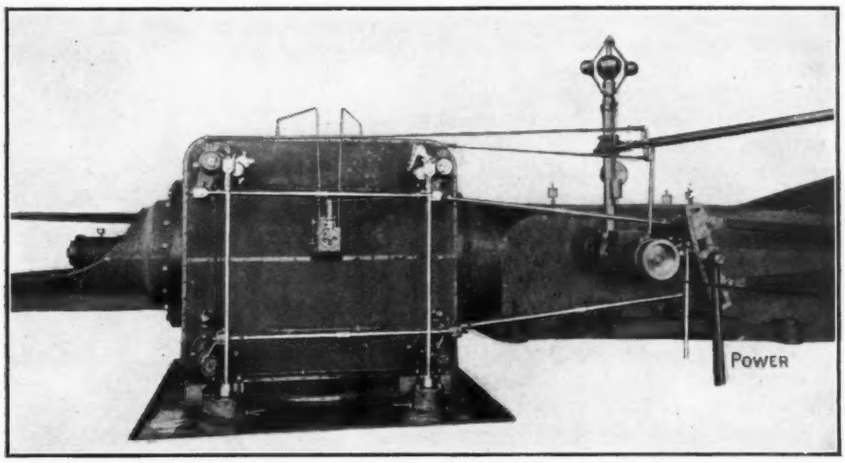



FIG. 2. VIEW OF VALVE GEAR, GOVERNOR AND LINK

"The governor is thrown out of action by means of a lever which is connected by a link to a camshaft, as you will notice in the other illustrations."

I looked at the photographs represented in Figs. 3 to 7 and nodded assent, for the cam arrangement was plainly shown.

"Since the governor is controlling," continued Hunter, "the cam is in a neutral position, and the cam arm to which the rod connecting to the governor is attached is out of contact with the cam. This position is shown in Figs. 3, 4 and 6. The position of the cam is also shown when the engine is running forward and running reverse in Figs. 4 and 6. This position of the link is also shown for the two directions of rotation.

"Now, take Fig. 3; what will the engine do with the governor and link set as shown?"

I studied the picture a moment and then said that the engine would either be at rest after running forward or was running slowly forward throttled, with no cutoff, but with the governor in control.

"Pretty good for a beginner," laughed Hunter; "in fact, that is just the condition. Now Take Fig. 4; conditions are the same, aren't they?"

I studied Fig. 4 and decided that Hunter would make an excellent examiner up in Masachusetts. Apparently, the illustrations were the same, but a closer examination showed that the cam arm was now in a lower position and the governor in a higher plane, which would indicate an earlier cutoff than shown by Fig. 3. The direction of rotation would be the same and the governor would control the cutoff. This is what I told Hunter, who replied: "Right again. Now let's try our luck on Fig. 5."

"To all appearances," said I, "this illustration shows that the engine was running reverse, but a second look shows that the engine is running forward, although the link is shown in the reversed position. This being the case, the engine is running full speed forward, the direction of rotation being shown by the arrow at the governor pulleys. The governor is out because the cam has lifted the rods connecting with the governor and the latest cutoff is taking place.

"I see what is occurring!" I exclaimed, as a light began to dawn. "The engine is in a plugged condition; that is, it is running forward, but steam is being admitted so that the piston meets live-steam pressure as it nears the end of its stroke."

"That is what takes place," replied Hunter. "In Fig. 6 the engine is shown running full speed in a reversed position, with the latest cutoff taking place, the governor controlling. In Fig. 7 the engine is shown running full speed reverse, but no cutoff occurs, as the governor is out of action."

"Do these engines run condensing?" I asked, as no mention had been made regarding the matter.

"No; in fact, none of the hoisting engines I have seen run condensing and, so far as I am aware, no attempt has been made to run them so in this country. You see a winding engine is operated intermittently and often under extreme variation of power. Therefore, the problem of condensing is rather complicated.

"I did read about ten years ago where a condensing hoisting plant was outlined, but the idea has never been given a practical test, so far as I know. As I remember, the general arrangement was to have a central condensing chamber with an air pump operated from the engine. There was also a second air pump which ran continuously, regardless of whether the engine was in operation.

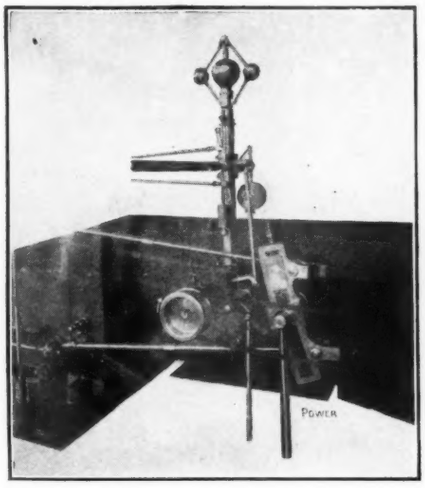



FIG. 3. AT REST AFTER RUNNING FORWARD OR RUNNING FORWARD SLOWLY, NO CUTOFF GOVERNOR CONTROLLING

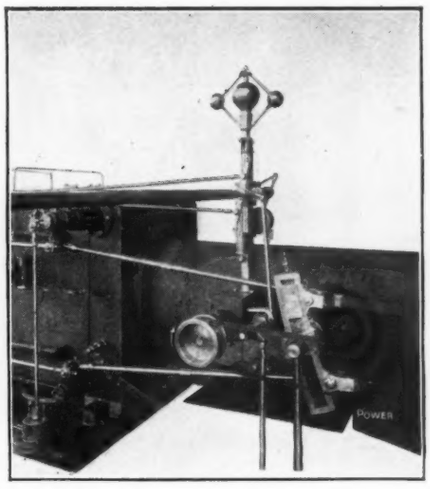



FIG. 4. RUNNING FORWARD AT FULL SPEED, EARLIEST CUTOFF GOVERNOR CONTROLLING

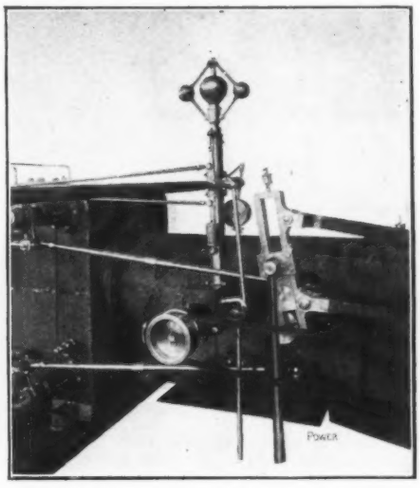



FIG. 5. PLUGGED, RUNNING FORWARD AT FULL SPEED, LATEST CUTOFF, GOVERNOR OUT

This air pump was used to maintain a vacuum while the main vacuum pump, which was attached to the engine, was at rest.

"A continuous injector and steam supply were to be maintained at the continuously operated air pump, but the injection water supplied to the intermittently operated air pump was controlled by the throttle-valve lever; that is, it was to be shut off and turned on to the engine condenser simultaneously with the steam.

"The pump that was to be in constant use was to give a regular supply to an accumulator injector tank, and while the winding engine was operating this water supply was to pass directly to the engine condenser, but its flow would be stopped by a connection in the main steam valve at the same time it was closed.

"When this was done, the water supply was to be forced into the accumulator against the pressure built up by its own volume, there being no means for the air to escape until an excessive pressure was reached. As soon as the steam throttle valve was open the injection valve was also open and the water in the accumulator, being under pressure, would flow and act immediately on the condenser and so eliminate any chance of losing the vacuum before the main injector supply could get into action."

"It might work out," I remarked, as Hunter flicked the ashes from his cigar, "but it looks somewhat complicated."

"Well, I don't think the idea ever was put into practice, at least in a commercial way. There have been and are condensing engines at collieries, but the character of the winding work makes it difficult to apply the practice of condensing in such a manner as to attain the highest efficiency or economy."

With these remarks, Hunter threw his partly consumed cigar away and bade me good night, leaving me to wonder if there were many engineering subjects which he did not understand.

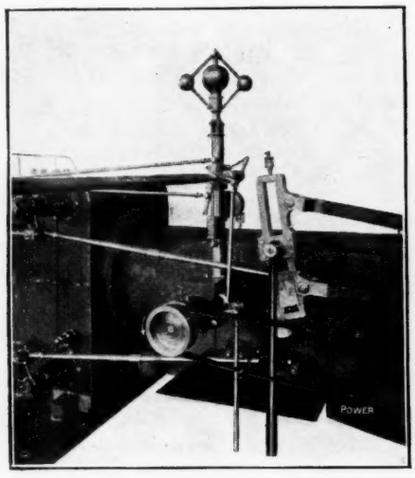



FIG. 6. RUNNING REVERSED AT FULL SPEED, LATEST CUTOFF GOVERNOR CONTROLLING

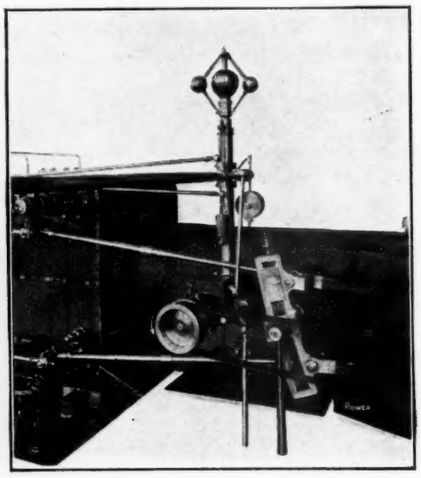



FIG. 7. PLUGGED REVERSED AT FULL SPEED, NO CUTOFF, GOVERNOR OUT

## Rapid Engine Alignment

BY F. C. HOLLY

In no part of the erection of an engine is there more necessity for the exercise of skill than in its alignment.

The methods I use may not be original and may not be the best, but are an improvement over some that I have often seen employed.

A moderate-sized horizontal, girder-frame Corliss engine is to be erected. This type is selected because it is perhaps the most nearly representative of engine-aligning work in general and embodies all the principles of lining and leveling encountered in erecting horizontal engines of any type or size.

The first step after the engine is assembled is to provide suitable devices to hold a line in the exact center of the cylinder. For the head end a very familiar device for the purpose is the iron bracket shown in Fig. 1. By having the nut only partly tight, the bracket may be tapped with a hammer in the direction necessary to bring the line to the center. Another device is shown in Fig. 2, no forge or blacksmith being required to make it. A strip of soft wood ¾x1½ in. is cut the right length to drive firmly into the counterbore. A ¼-in. hole is bored through the stick at the middle and a piece of tin about 1¼ in. square with two opposite corners bent as shown is driven into the stick over the hole. The center is then scribed on the tin, a sharp-pointed hermaphrodite compass being used for the purpose, and a hole the size of the line pricked, through which the line is passed. Usually when the line is stretched and centered in the gland it will be found accurately centered in the counterbore, but, if not, a very light tap with the hammer up or down on the stick or of a flat tool sideways on the tin will suffice to make it so.

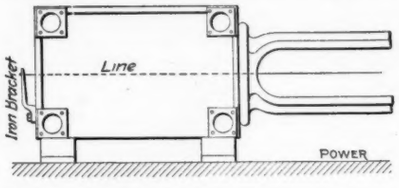



FIG. 1. BRACKET FOR HOLDING CENTERING LINE

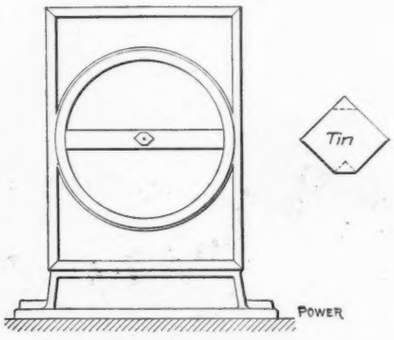



FIG. 2. ANOTHER CENTERING LINE SUPPORT

For holding the line in place at the crank end an efficient device is shown in Fig. 4. This, being attached to the frame and extended to clear the crank, will serve both in the testing of the cylinder for alignment to the frame and the squaring of the crankshaft to the center line.

A method I have often seen used is shown in Fig. 3. As this is attached to the floor and any movement or adjustment of the engine frame makes necessary the re-centering of the line in the cylinder, it is evident that much time is lost in this manner unless the engine must be set to this particular line. For centering the line a soft pine stick about ¼ in. in diameter, with common pins driven into each end, makes a very satisfactory tram. The pins can be driven in to suit the most refined adjustment and when lightly held between the first finger and thumb the slightest touch of the line can be plainly felt.

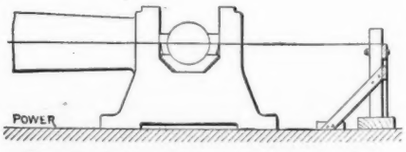



FIG. 3. HOLDING THE LINE AT THE CRANK END

In squaring the crank to the line an ordinary rule, its end held against the crank face, will be found superior to either tram or calipers.

In leveling the frame and cylinder only six wedges are needed. These, when placed as shown in Fig. 4, illustrate a principle in wedging that can often be used to advantage. By driving wedges

*A, B, C* and *D*, the engine can be leveled lengthwise, while by lateral wedges both the cylinder and frame may be leveled crosswise, *A, B, C* and *D* acting as rests upon which the weight is practically balanced. Excepting in very heavy work, a multiplicity of wedges should be avoided.

After the lining up and leveling are completed, a wedge or tight-fitting shim should be placed under the frame near each anchor bolt and the nuts drawn tight enough to prevent the possibility of the alignment being disturbed while the engine is being bedded. This is especially important if a rust joint is used, as this style of joint is tightly rammed under the frame and cylinder feet and the ramming is certain to throw the frame out of line vertically if it is not snugly bolted down.

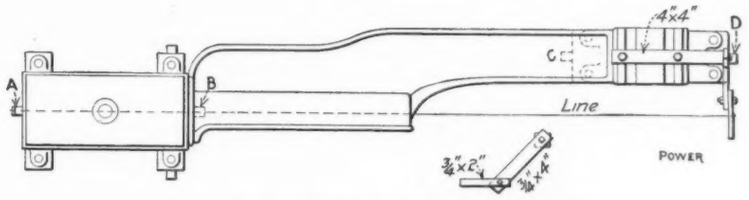



FIG. 4. ARRANGEMENT OF LEVELING WEDGES

## Saving by Heating Boiler Feed Water

BY W. M. WRIGHT

Every heat unit added to the feed water before entering the boiler which does not come directly from the coal means a saving.

To readily determine what percentage of saving may be effected by the installation of apparatus to heat the water, the accompanying chart may be used.

It is noticeable that the higher the initial temperature of the water, the greater will be the percentage of saving for a given increase in temperature. For instance, the chart shows that in heating the water from 50 to 100 deg. temperature there is a saving of $4\frac{3}{10}$ per cent. and that in heating it from 150 to 200 deg. a saving of $4\frac{7}{10}$ per cent. is made.

To use the chart, read horizontally from the final temperature of the water to the diagonal line leading from the initial temperature and then vertically downward to percentage scale. This chart is calculated for 100 lb. boiler pressure. For 50 lb. pressure, percentages are less than 0.15 higher. For 200 lb. pressure, percentages are less than 0.2 lower.

## Repairing Boiler Tubes

BY JOHN BURNS

Nothing is more discouraging to the engineer than to discover a bagged plate when the boiler is taken out of service, or in the case of a water-tube boiler, a number of bulged boiler tubes. In most cases, the primary cause is oil or grease in the feed water, or the use of a feed water that leaves a gummy deposit of the nature of soapstone or mica.

The writer's experience with defects of this kind has until recent years been confined to the horizontal return-tubular boiler, but the purpose of this article is to extend the practice to the driving or rolling back of bulges on boiler tubes, thereby saving the tube and the cost of

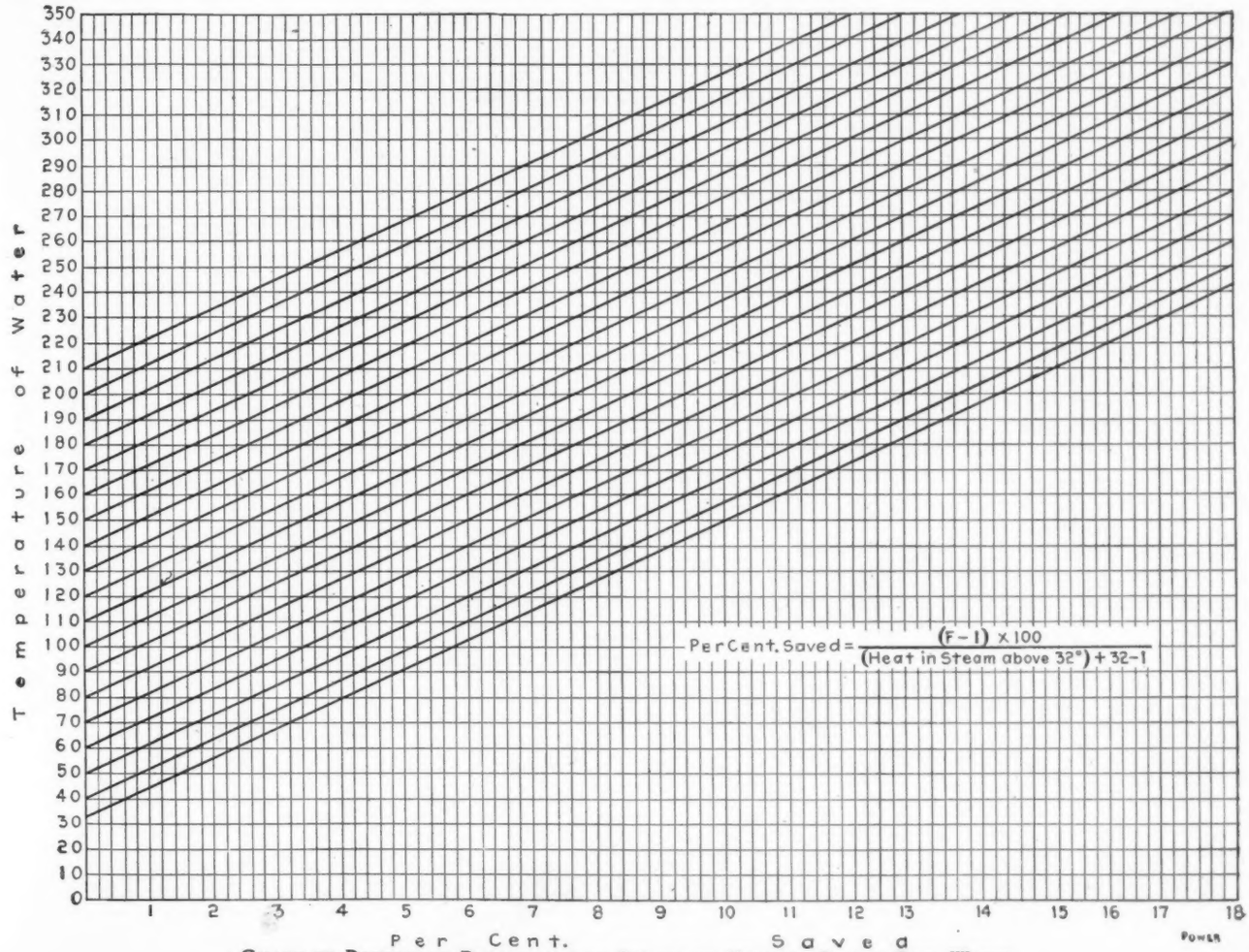
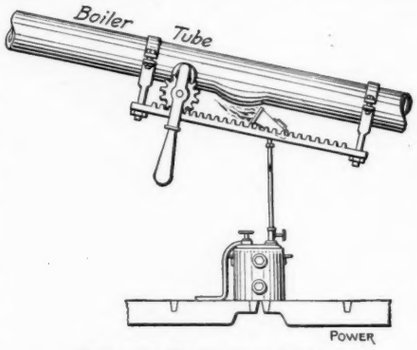



CHART TO DETERMINE PERCENTAGE OF SAVING BY HEATING BOILER FEED WATER

removal. It has been the custom with water-tube boilers to allow bulged tubes to remain in this condition until the bag bursts and a stream of water is discharged which threatens to put out the fire.

I have in mind an instance where a large town in West Virginia was without electric service an entire week on account of bulged boiler tubes. Some time ago the writer had an experience that came very near being as disastrous; in this case the trouble was caused by oil in the feed water. When two boilers were taken out of service for their usual cleaning the attendant discovered that nearly every tube in the bottom rows of the boilers were bulged and some of the tubes in three or four places; in fact, it looked as though another day's firing would have completed the destruction of the entire bottom rows of tubes. The boilers had been in service but six months. The loss of so many practically new tubes was disheartening, but something had to be done, and done quickly, as the other boilers were doubtless in the same condition.

We secured a large gasoline blow-torch of the furnace type and the blacksmith was instructed to make a swage that would exactly fit the circumference of the tube. The boilers were drained out, and with a sledge, after heating, we started driving back the bulges. I wish to say right here that this was no pink tea, for at every blow of the sledge we were treated to a shower-bath of soot and ashes. However, we made fairly good




ROLLING BACK THE BULGES

progress until it was discovered that the blows from the sledge hammer were having a bad effect on the tube ends where they were expanded into the headers. The clamps and roller shown in the accompanying illustration were then devised, and with an extension blow pipe about 4 ft. long so that the torch could rest on the grate bars while heating was taking place, we again started operations, and this time with better results. We heated and rolled back all of the bulges; the tubes were made as good as new. In fact, the operation was performed on one tube that was bulged so badly that it had started leaking; this same tube was removed a year later.

It should be understood that the plant is in operation 24 hr. a day, and by a little careful watching and making repairs as described, we have lost but nine tubes since the plant was started in 1908, an average of less than three tubes a year. It might be added, however, that an asbestos-lined hood of sheet iron, made to fit around the tube with a hole in the bottom to admit the flame of the blow-torch, greatly facilitated the heating. Later I thought so much of the device that I had it patented, not for the purpose of preventing the use of the roller method of repairing tubes by engineers, but to derive some revenue from parties who should undertake to manufacture and market it.

# Deterioration of Coal in Storage

By A. Bement*

**Results of tests of coal exposed to the weather for one year to determine the deterioration due to change in weight and in its heating power.**

*Consulting engineer.

In POWER, Jan. 2, an article under the above title by H. C. Porter and F. K. Ovitz discussed investigations of coal deterioration, and referred to experiments made by the present writer. As a matter of further information, the results of these tests are here given in some detail.

The tests included determining the change in heating power, the change in weight and the tendency to disintegrate by slaking.

The character and quality of the four kinds of coal tested are shown by Tables 1 and 2. How one year's storage out of doors affected heating power and weight is shown in Table 3, and the results of tests of the second best and poorest coal under water, in Table 4. Table 5 shows the disposition to disintegrate into smaller pieces.

During the last few years the writer has made several investigations. The first consisted in experiments to ascertain the loss in heating power only. While that work was largely preliminary, it indicated that the loss in heat value is much smaller than generally supposed. At the end of the first year's work, it was decided that change in weight of fuel is also important, so the second year tests of this were included. While the work gave useful results and developed an accurate method of testing, it was really preliminary. Then with the benefit of two years' experience, another series of tests was planned and carried out very successfully.

The greatest difficulty was accurately determining the change in weight. Under common conditions of weather exposure a sample may increase in quantity by collecting dust and dirt blown into it by the wind and decrease by losing small particles carried away by rain and wind. To isolate these effects, coal containing no dust was selected, placed in a box large enough to hold 400 lb. and covered with cheesecloth to catch dirt. Drainage from the box was caused to flow at low velocity through a trough containing dams or riffles to catch any dust carried out with the water. All of the coal in the sample passed over a screen having ¼-in. round perforations and through another with ⅝-in. perforations. This sample in an air-dry state was carefully rescreened over ⅜-in. perforations, eliminating all small stuff and leaving clean coal of uniform size, which was then sampled and analyzed. The remainder was weighed and placed in storage in the box.

When the coal was removed from storage its weight was taken, after which it was sampled and again analyzed. The heating-power determinations were made with a Mahler calorimeter at the same time the analyses were made. In determining the change of weight, calculations were based on the same moisture content initially present in the coal. This was because coal increases and decreases in moisture content independently of any change that may affect the ash content or that of the coal proper. Thus the final weight of the dry coal referred to

TABLE 1. PROXIMATE COMPOSITION OF COALS

| | Coal A | Coal B | Coal C | Coal D |
|---|---|---|---|---|
| Moist coal | | | | |
| Moisture, per cent. | 6.75 | 9.65 | 12.66 | 14.38 |
| Ash, per cent | 7.23 | 10.99 | 10.75 | 10.01 |
| Volatile matter, per cent | 35.36 | 31.55 | 37.23 | 36.23 |
| Fixed carbon, per cent | 50.66 | 47.81 | 39.36 | 39.38 |
| Heating power in B.t.u. | 12,944 | 11,178 | 10,990 | 10,774 |
| Dry coal | | | | |
| Ash, per cent | 7.75 | 12.16 | 12.31 | 11.69 |
| Volatile matter, per cent | 37.92 | 34.92 | 42.63 | 42.32 |
| Fixed carbon, per cent | 54 33 | 52.92 | 45.06 | 45.99 |
| Heating power in B.t.u. | 13,882 | 12,803 | 12,583 | 12,584 |
| Pure coal | | | | |
| Volatile matter, per cent | 41.11 | 39.75 | 48.61 | 47.92 |
| Fixed carbon, per cent | 58.89 | 60.25 | 51.39 | 52.08 |
| Heating power in B.t.u. | 15,048 | 14,575 | 14,350 | 14,250 |

its initial weight gave the change due to weathering.

The tendency of coal to disintegrate by slaking down to smaller sizes was considered sufficiently important to test carefully. A goodly number of average lumps of coal from each of the kinds were placed in outdoor storage for one year after being weighed. These lumps were so placed that the portion scaling off remained associated with the original lump. At the end of the year what remained intact of the original lumps was weighed, and the total weight referred to the original weight gave the percentage of the original lump that was not disintegrated. The slaked-off portion was separated into sizes each of which was also weighed, so that in addition to knowing to what extent the sample remained as lump, it was found into what sized pieces the disintegrated portion was disposed to separate.

TABLE 2. ULTIMATE COMPOSITION OF COALS

| | Coal A | Coal B | Coal C | Coal D |
|---|---|---|---|---|
| Carbon, per cent.... | 81.81 | 81.63 | 77.23 | 75.74 |
| Hydrogen, available, per cent..... | 4.24 | 4.02 | 4.02 | 3.63 |
| Sulphur, per cent.... | 2.04 | 2.14 | 4.45 | 5.24 |
| Nitrogen, per cent... | 1.79 | 1.73 | 1.60 | 1.51 |
| Water of combination, per cent..... | 10.12 | 10.48 | 12.70 | 13.88 |
| Total..... | 100.00 | 100.00 | 100.00 | 100.00 |
| Heating power per pound in B.t.u.... | 15,048 | 14,575 | 14,350 | 14,250 |

TABLE 3. CHANGE DUE TO EXPOSURE IN AIR FOR ONE YEAR

| | Change in Per Cent. | | |
|---|---|---|---|
| Coal | Heating Power | Weight | Total |
| A ..... | —0.25 | 0.00 | —0.25 |
| B ..... | —0.38 | +0.11 | —0.27 |
| C ..... | —0.93 | —1.15 | —2.08 |
| D ..... | —1.85 | —2.29 | —4.14 |

TABLE 4. CHANGE OCCURRING UNDER WATER, ONE YEAR'S STORAGE

| | Change in Per Cent. | | |
|---|---|---|---|
| Coal | Heating Power | Weight | Total |
| B ..... | +0.02 | —0.81 | —0.73 |
| D ..... | —0.44 | —0.35 | —0.79 |

TABLE 5. DISPOSITION TO SLAKE

Disposition of lump coal to slake down to smaller size. Exposure of one year. Original samples 100 per cent. lump, which in one year's outdoor storage broke down to sizes as shown.

| | Percentage of Each Size After One Year | | |
|---|---|---|---|
| Coal | Lump | Egg | Sizes 1- and ¼-in. and under |
| A ..... | 100.00 | 00.0 | 00.00 |
| B ..... | 87.84 | 00.0 | 12.16 |
| C ..... | 35.49 | 23.0 | 41.51 |
| D ..... | 18.36 | 16.5 | 65.14 |

## Chart for Determining Blowing Engine Speed

By J. C. Watson

It often happens in blast-furnace work that the air for the furnaces is supplied by two blowing engines of different sizes. As it is necessary for satisfactory operation to supply a definite amount of air to each furnace, this involves a calculation of the speed at which the engines should run to deliver the required amount.

A convenient way of determining these speeds without any calculations is by the use of a chart similar to the one shown herewith in Fig. 2. This chart is constructed as follows: Suppose that the blast furnace to be supplied uses not less than 30,000 nor more than 45,000 cu.ft. of free air per minute, and that the air is supplied by two blowing engines, one having a maximum speed of 75 r.p.m. and delivering 400 cu.ft. of free air per revolution, the other having a maximum speed of 100 r.p.m. and delivering 350 cu.ft. of free air per revolution.

Take a sheet of cross-section paper, as shown in Fig. 1; divide the left side into 75 equal parts, with the zero at the top to represent the maximum 75 r.p.m. of the 400-cu.ft. blowing engine. At the right side of the sheet choose another vertical line, and starting with the minimum number of cubic feet of air required per minute at the bottom of the sheet, divide this line into such a number of equal parts that the maximum number of cubic feet of air per minute will be shown on the sheet. It is immaterial whether this comes at the top line of the sheet or not; convenience in making the divisions will determine.

All that remains to be done to complete the chart is to determine the location of the line representing the 350-cu.ft. engine and the size of its divisions. In the present case the 400-cu.ft. engine, making 75 r.p.m., will pump 30,000 cu.ft. of air per minute, so the zero speed of the 350-cu.ft. engine lies somewhere on the line connecting these two points.

Now, if the 350-cu.ft. engine runs at 100 r.p.m., it pumps 35,000 cu.ft. of air per minute. So, if the zero point on the 400-cu.ft. engine line is connected with the 35,000 point on the volume line, it will be known that the point representing 100 r.p.m. of the 350-cu.ft. engine line lies somewhere on this connecting line. Likewise, if the 400-cu.ft. engine is running at 20 r.p.m., it blows 8000 cu.ft. of air per minute, and if this is added to the 35,000 cu.ft. blown by the 350-cu.ft. engine at 100 r.p.m., there is a total of 43,000 cu.ft. of air per minute blown by the two engines.

If, now, 20 is connected on the 400-cu.ft. engine line with 43,000 on the volume line, another line is located on which the point representing 100 r.p.m. of the 350-cu.ft. engine must lie. The intersection at *A*, Fig. 1, of the two lines determines the exact location of this point. The point of zero revolutions lies directly under this 100-revolutions point, so all that remains is to draw this line and divide it into 100 equal parts.

It is better, however, to locate a few more points, as *B* and *C*, in order to check the accuracy of the work. The completed chart is shown on Fig. 2.

Suppose that 42,250 cu.ft. of air per minute is required by the furnace, and that it is desired to run the 400-cu.ft. engine at 40 r.p.m.; then connect these two points with a straight-edge, as in Fig. 2, and it will be found that it crosses the 350-cu.ft. engine line at 75. This means that in order to attain the required result, this engine must be run at 75 r.p.m.

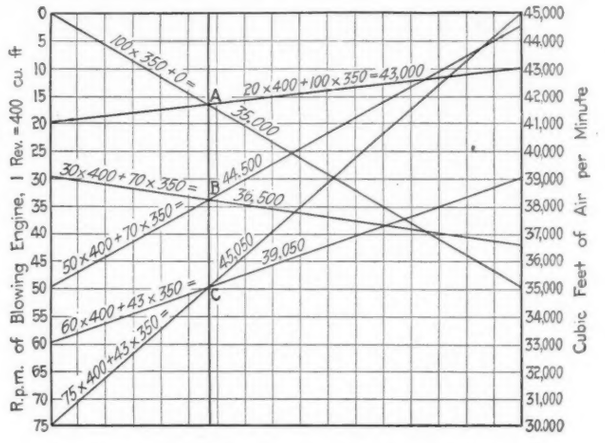



FIG. 1. METHOD OF LOCATING POINTS ON CHART

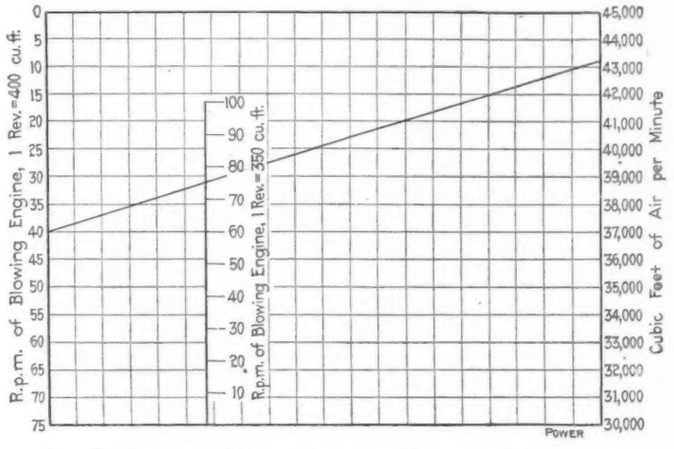



FIG. 2. FINISHED CHART, SHOWING VOLUME OF AIR PUMPED

# Water in the Low-Pressure Cylinder

By H. R. Low

**Low-pressure cylinders of compound engines are not infrequently wrecked by water which is usually supposed to come from the condenser. The article shows how it may be brought over from the boiler in quantities too small to fill the high-pressure clearance and accumulate in the receiver until swept into the low-pressure cylinder.**

It not infrequently happens that a compound condensing engine which has hitherto been well behaved and given no trouble to speak of will suddenly take a dose of water into the low-pressure cylinder, resulting in a wreck of greater or less magnitude with all its attendant disagreeable features: loss of the unit in service, a repair bill, a disgruntled owner and superintendent and a sore engineer to whom everybody is looking for an explanation. Almost the first question asked upon such an occasion is, "Where did the water come from?"

There are many who fail to understand how it is that the low-pressure piston can and does act as a pump and pull the water over into the low-pressure cylinder; not from the condenser, but from the boilers. In the opinion of many, the condenser is a sort of suspicious character and the first to be blamed as the only source that they can see from which the water can come. But "How," they ask, "does the water get through the high-pressure side without wrecking it?"

Perhaps a few minutes spent in the consideration of this subject may prove instructive and profitable, for having once found and understood the cause we may be better able to use means of prevention against further similar mishaps.

As most of the wrecks that have come to the notice of the writer have happened to engines of the cross-compound condensing type, assume an engine of this sort with the low-pressure cylinder twice the diameter of the high, in which case it will have four times the area and volume, since the stroke is the same. Let the initial pressure be 150 lb. absolute and the cutoff on the low-pressure fixed for one-third stroke.

Supposing the engine to be running with a fair load—say, cutting off at quarter stroke on the high-pressure cylinder—and that the pressure varies inversely as the volume, the pressure at the end of the stroke of the high-pressure cylinder will be

$$150 \div 4 = 37.5 \text{ } lb.$$

as at *A* in Fig. 1. The volume of the high-pressure cylinder is one-quarter that of the low. If the low-pressure cut off at one-quarter stroke it would take the same volume out of the receiver at each stroke that the high-pressure cylinder delivered to it. The receiver pressure would be the same as the high-pressure terminal and the high-pressure diagram would end in a point.

But the low-pressure cylinder cutting off at one-third stroke takes a larger volume out of the receiver at each stroke than the high-pressure cylinder delivers to it. The steam at this greater volume has a correspondingly less pressure. Whatever happens to it in the meantime, when the steam has been expanded to the end of the stroke in the low-pressure cylinder it will have four times the volume that it had at the end of the high-pressure stroke because the low-pressure cylinder, into which it is delivered and ultimately expanded, is four times as large as the high.

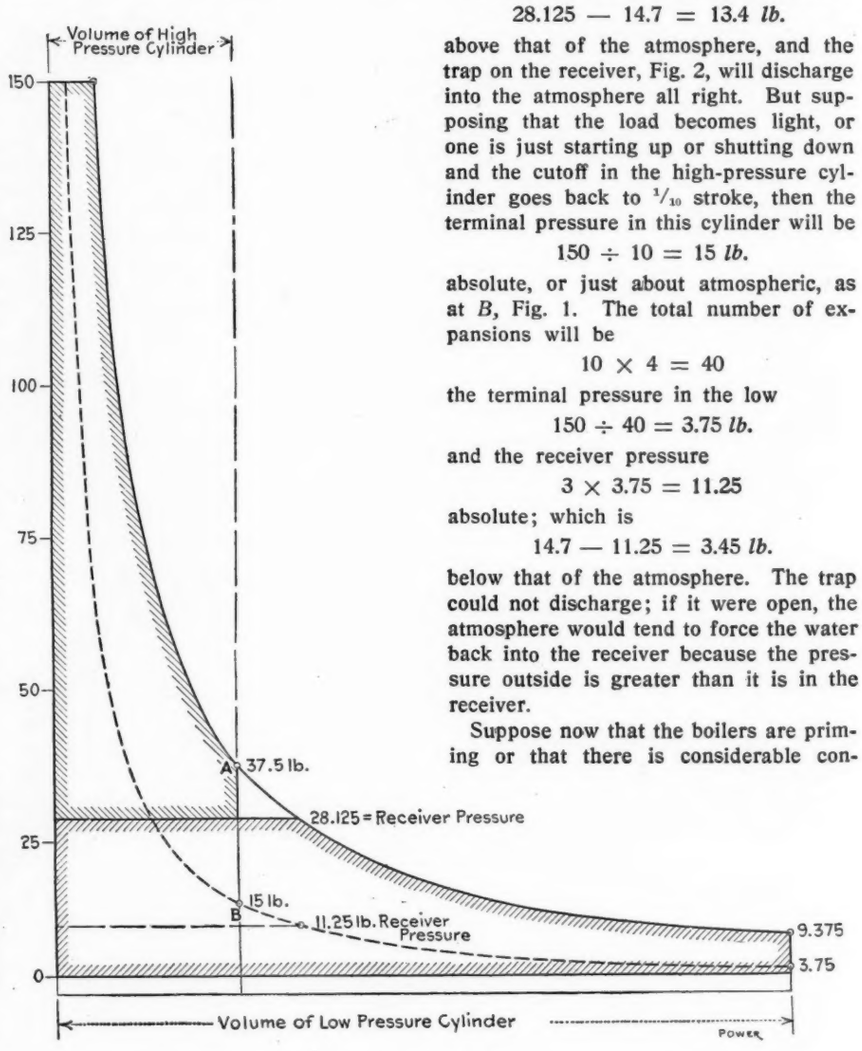



FIG. 1

If it had already been expanded four times in the high it would be expanded

$$4 \times 4 = 16$$

times in all and the terminal pressure in the low would be

$$150 \div 16 = 9.375 \text{ } lb.$$

With the cutoff at one-third, the initial pressure in the low (the receiver pressure) will be

$$9.375 \times 3 = 28.125 \text{ } lb.$$

An ideal diagram for the high-pressure cylinder drawn to the same pressure scale as the low, but shortened to one-quarter, the length of the low-pressure diagram would look like the upper part of Fig. 1 while the lower portion would represent the ideal low-pressure diagram.

In this case the receiver pressure is

$$28.125 - 14.7 = 13.4 \text{ } lb.$$

above that of the atmosphere, and the trap on the receiver, Fig. 2, will discharge into the atmosphere all right. But supposing that the load becomes light, or one is just starting up or shutting down and the cutoff in the high-pressure cylinder goes back to $^1/_{10}$ stroke, then the terminal pressure in this cylinder will be

$$150 \div 10 = 15 \text{ } lb.$$

absolute, or just about atmospheric, as at *B*, Fig. 1. The total number of expansions will be

$$10 \times 4 = 40$$

the terminal pressure in the low

$$150 \div 40 = 3.75 \text{ } lb.$$

and the receiver pressure

$$3 \times 3.75 = 11.25$$

absolute; which is

$$14.7 - 11.25 = 3.45 \text{ } lb.$$

below that of the atmosphere. The trap could not discharge; if it were open, the atmosphere would tend to force the water back into the receiver because the pressure outside is greater than it is in the receiver.

Suppose now that the boilers are priming or that there is considerable condensation—as there is apt to be on starting up—and water accumulates in the receiver as shown in Fig. 2. When the

low-pressure piston moves away from the head the steam from the receiver flows into the space which it leaves. If the water ever gets so high as to cover up the opening at *A*, Fig. 2, the water would be forced up the pipe *C* with a force equal to the difference between the pressure in the receiver and that in the vacuous space which the piston left behind it.

It would not be necessary for the water to become high enough to completely shut off the space at *A*, for when this opening became restricted the inrushing steam would cause the water to surge until it filled the section at the elbow and up would go a slug of water to the cylinder. It takes only a trifle more than enough to fill the clearance to do the damage.

The same thing may happen all the more readily at full load if for any reason the traps fail to work, because there will be a greater pressure difference between the receiver and the low-pressure cylinder when the piston starts off and a more lusty flow to carry the water over.

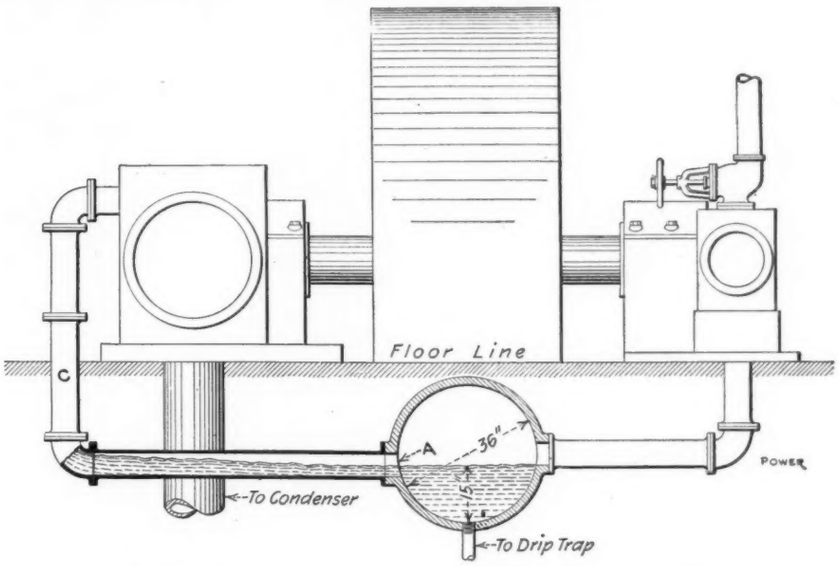



FIG. 2. HOW WATER GETS INTO THE LOW-PRESSURE CYLINDER

Fig. 2 is drawn to scale from an engine with which I am well acquainted and there are many more similarly arranged.

When I start up a compound engine I always shorten the cutoff on the low-pressure cylinder to build up the pressure in the receiver and keep the trap working until the engine gets its load; then I set the low-pressure cutoff ahead and let the receiver pressure down to what I want to carry.

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A Swedish inventor claims to have devised means for burning pulverized peat in a locomotive as practically and economically as coal.

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The total number of central stations in Germany is reported to be about 2700.

## Centrifugal Pump Troubles

BY F. WEBSTER

Centrifugal pumps do not produce an over-rise of pressure; hence there are no shocks or disruptive stresses. On the other hand, each type of pumps has its peculiarities, and the operator must study them in order to be master of the situation.

The ordinary size of centrifugal boiler feeder runs at about 3600 r.p.m., and when in order it is perfectly silent and free from vibration. Sometimes it will run for months with practically no attention save the inspection of the oiling and cooling systems, but when it does get out of order a diagnosis must be made and a cure attained.

### AILMENTS

Different ailments are contracted by this type of boiler feeders. One power-plant engineer has found that getting out of balance is the most serious, the affection generally coming on instantly and changing the conditions suddenly from perfect running to a noisy vibration; then there is nothing to do but shut down and dismantle the machine.

In two cases a sprung shaft seemed to be the trouble, and it seemed idle to try any scheme for getting the rotor in balance except by putting in a new shaft and a set of new bearing sleeves. This method produced a cure, and gave the diagnosis after the prescription had been tried. Hence, the rule in case of trouble is to get new parts.

### OUT OF BALANCE

That a rotor getting out of balance will cause a breakdown is accepted, but the cause of its getting unbalanced is not always clear. In the investigation of a recent case of sprung shaft a clue appeared in a little sliver of babbitt weighing probably less than ½ oz., which was found lodged in the groove between the outer edge of the driving disk and the ring carrying the steam vanes of the turbine, as shown in the illustration. This babbitt came from the shaft bushing, having broken from a spongy place in the casting. The unbalancing effect of this small piece—or by whatever else it may have been caused—was instantaneous. There were no immediate steps in the breakdown; the machine went at one leap from perfection to destruction.

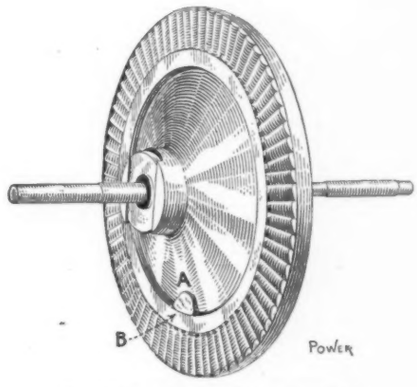
### CENTRIFUGAL FORCE

Calculation relates to the theory of the unbalancing effect of any given weight would be that the centrifugal force equals

$$F = \frac{W V^2}{Rg}$$

where

$W = ½$ oz. $= \frac{1}{32}$ lb.;
$R = 10$ in. $= \frac{5}{6}$ ft.;
$G = 32.16$;




BABBITT LODGED ON IMPELLER

$V$ = Velocity in feet per second.
For an r.p.m. of 3600, $V$ will equal

$$\pi \times \frac{5}{6} \times 2 \times 3600 \div 60$$

and

$$F = \frac{1}{32} \times (3.1416 \times \frac{5}{6} \times 2 \times 3600 \div 60)^2 \div \frac{5}{6} \times 32.16 = 115 \text{ lb.}$$

This unbalanced weight would be applied as a concentrated load at the middle of a shaft, probably 3 ft. or so long. The theoretical deflection with a 1½-in. shaft would be about 0.01 in., according to the formula

$$f = \frac{W l^3}{48 E I}$$

where

$W$ = Weight in pounds;
$l$ = Length between the bearings in inches;
$E$ = Coefficient of elasticity, which for steel is 30,000,000;
$I$ = Moment of inertia in inches of the shaft.

For a 1½-in. shaft $I = 3.08$. The actual deflection may be much greater.

# Electrical Department

**Conducted to be of service to the men in charge of electrical equipment in the power house**

## Rotary Converters and Their Operation

By Norman G. Meade

A rotary converter combines in one machine the functions of a motor and generator, and forms the electrical connection between an alternating and a direct-current system. As usually installed, it acts as a synchronous motor driving a direct-current generator, but it can be inverted so as to consist of a direct-current motor driving an alternating-current generator. If mechanically driven it will supply both direct and alternating currents.

In construction a rotary converter is similar to a direct-current generator, with the addition of suitable collector rings connected to the armature winding at points having the proper phase relation. It can be built for single-, two-, three- or six-phase circuits, but single-phase converters are seldom employed. Transformers are generally interposed between the converter and the alternating-current system to lower or raise the voltage. This is usually necessary, owing to the fixed relation between the direct- and alternating-current voltages of the converter, and the desirability of high-tension transmission.

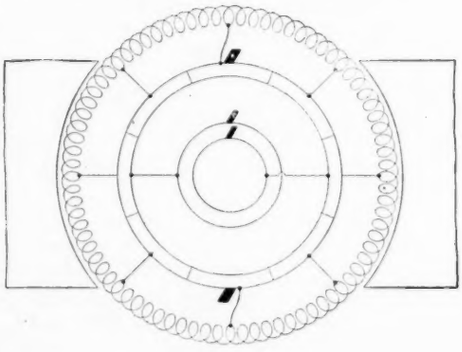


Fig. 1

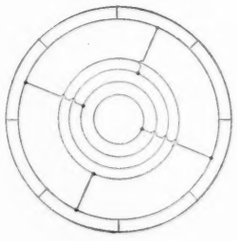


Fig. 2

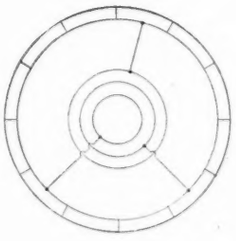


Fig. 3

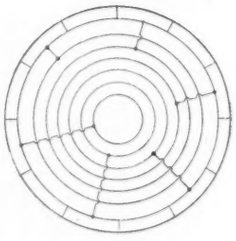


Fig. 4

Elementary Rotary Converter Windings for Different Phases

### Classification of Rotary Converters

To illustrate its performance let Fig. 1 represent the rotary converter armature revolving in a two-pole magnetic field, two poles being chosen for simplicity. If the machine be equipped with both a commutator and collector rings, it may be run as an ordinary direct-current motor. The conductors on the revolving armature will be cutting lines of force exactly as though the armature were revolved mechanically; alternating currents will therefore be obtained from the collector rings. If the operation be reversed and the machine run as a synchronous motor, the alternating currents will be transformed to direct current.

By connecting four equidistant points of the winding to four collector rings, as in Fig. 2, two-phase or quarter-phase currents will be obtained and there will be two pairs of conductors in the alternating-current line. By connecting three equidistant points of the armature winding as in Fig. 3, three-phase currents will be delivered. Since direct-current armatures have closed circuit windings, the connections on the alternating-current side of a three-phase rotary converter are always delta.

In most recent large installations, six-phase rotary converters are used, operated by double-star or double-delta connections from three-phase transmission lines. In six-phase rotary converters six equidistant taps are led from the armature winding to six collector rings, as in Fig. 4. Figs. 5 and 6 show respectively the alternating-current and direct-current sides of a standard six-phase rotary converter. The advantage of such a machine arises from its relatively lower armature copper loss. It is usually of large current capacity as the more complicated connections in the transformers and at the collector ring brush-holders outweigh the advantages in smaller machines.

The diagrams have shown two-pole rotary converters only. In practice multipolar machines are used to reduce the speed. With two poles only one connection to each ring was necessary. In multipolar machines as many connections to each ring are required as there are pairs of poles.

The ratio between the potential at the alternating-current side and at the direct-current side is approximately constant and cannot be altered by changing the speed or by using a field rheostat. With a sinusoidal curve of electromotive force the following ratios of conversion are approximated, the potential at the direct-current side being taken as unity: In single- and two-phase machines the potential at the collector rings will be 0.71; three-phase, 0.61; six-phase, 0.71, or 0.61, depending upon whether a star or a double-delta connection is used. Thus a two-phase rotary converter receiving alternating currents at approximately 426 volts will deliver direct current at 600 volts, and a three-phase rotary converter with approximately 366 volts on the alternating-current side will deliver a 600-volt direct current.

Rotary converters can be used to supply three-wire systems, or to obtain two potentials for operating variable-speed direct-current motors. For such circuits a neutral wire is used in conjunction with the positive and negative leads on the direct-current side. When two-phase distribution is used the direct-current neutral wire can be connected to the middle point of the secondary coils of the transformers. Upon three-phase systems the transformer secondary coils are connected in the interconnected star system and the neutral is brought out from the common junction point of the secondary coils.

The relationship between the number of poles, the speed and the frequency of rotary converters is the same as that of alternating-current generators; that is,

the frequency equals the number of poles multiplied by the revolutions per minute divided by 120.

### Hunting

A converter must run in synchronism with the generator supplying it, but if the speed of the latter is not uniform, the converter will tend to follow the fluctuations of the generator speed. If the generator speed increases, the converter will tend to acquire a similar relative speed, but the momentum of the moving armature carries it beyond this speed, after which it will retard, thus causing a surging action. This is commonly known as "hunting" and may assume disastrous proportions if not provided against. As hunting is an oscillation each side of the synchronous speed, the corrective currents set up by it flow first in one direction then in the other. The effect is to cause the magnetic field continually to shift back and forth across the pole face. A similar action also occurs in the generator. That hunting is always accompanied by a shifting field, makes possible an effective preventive. This is a heavy copper grid surrounding each pole piece and having its cross bars embedded in slots in the pole face. Acting as dampers, these grids prevent the relative position of the converter armature from being changed by the corrective currents more than the initial change in the generator.

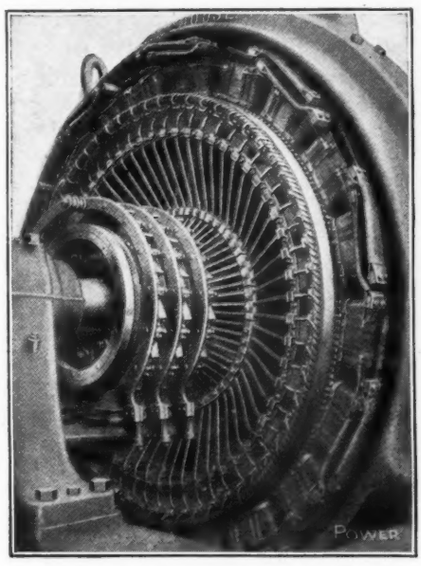



Fig. 5. Alternating-Current Side

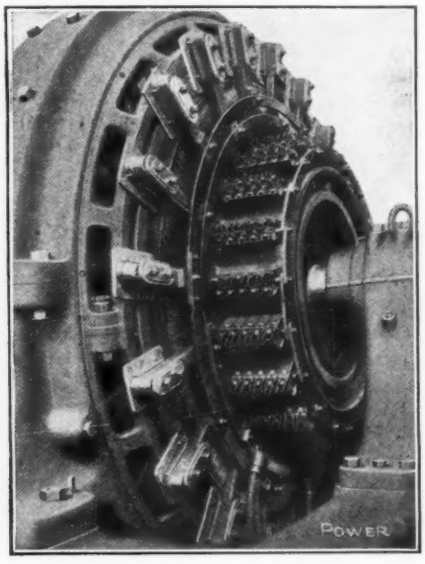



Fig. 6. Direct-Current Side

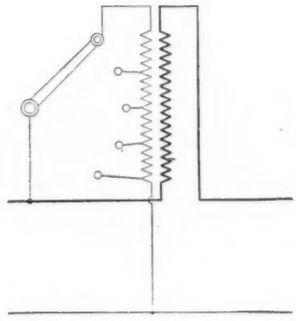


Fig. 7. Diagram of Potential Regulation

### Voltage Regulation

Regulation of the direct-current voltage can only be obtained by changing the alternating-current voltage. The regulation can be nonautomatic by means of transformer loops, potential regulators, induction regulators or by the synchronous regulator or alternating-current booster. Automatic regulation is possible, within narrow limits, by using a series winding in the field, and with the necessary control apparatus the induction regulator and the synchronous regulator can be arranged to operate automatically.

Transformers designed for service with rotary converters have taps on both the high- and the low-tension windings, for obtaining small variations in voltage. This means of altering the potential, however, cannot be used while the apparatus is in service.

The potential regulator shown diagrammatically in Fig. 7 consists of a special transformer having the primary coil connected across and the secondary coil in series with the line. Several taps are taken from the primary coil to contact points on a faceplate or drum. A reversing switch is provided and the voltage can be increased or diminished without regard to the line voltage.

The induction regulator consists of a transformer, the primary coils of which are movable, with respect to the secondary coils. The core and winding construction resembles that of an induction motor. The primary coil is connected across and the secondary coil in series with the line. By shifting the position of the primary winding of the regulator, the voltage delivered to the alternating-current side of the converter can be raised or lowered without opening the circuit and the voltage on the direct-current side will be varied.

Still another method of regulation is to use an alternating-current generator having the same number of poles as the rotary converter and having its rotor mounted on the same shaft with the converter armature, between the armature windings and the collector rings. The regulator frame, with its pole pieces and field winding, is carried by brackets from the frame of the converter. This avoids brushes and collector rings for the regulator, and the main field winding of the converter is free from regulating devices. A converter of this type, manufactured by the Westinghouse Co., is shown in Fig. 8.

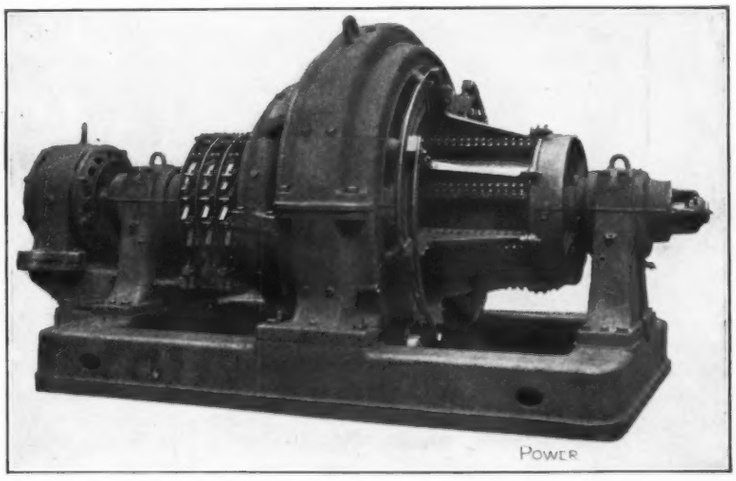



Fig. 8. Converter with Synchronous Regulator

With this regulator the direct-current voltage can be raised or lowered by altering the strength and polarity of the booster fields; a synchronous regulator rated at 15 per cent. of the capacity of the converter is capable of varying the voltage 30 per cent. This regulation

can be accomplished by hand or automatically and the regulator field can be controlled to maintain a constant potential or a constant proportion of the load on the rotary converter. The latter is particularly desirable when operating in parallel with other rotary converters or with storage batteries.

COMPOUNDING OF ROTARY CONVERTERS

The field strength of a rotary converter can be adjusted so that the direct-current output will be obtained with a minimum alternating-current input; varying the field strength either way will increase the input, while the output remains the same.

An over-excited field sets up a leading current in the line, and a lagging line current arises from an under-excited field. These changes in field strength do not appreciably affect the direct-current voltage, and the only way to vary the potential is to vary the alternating-current voltage at the collector rings, owing to the fixed ratio between the two electromotive forces. However, it is possible by proportioning the series excitation and providing sufficient inductance in the supply line to produce a change in the voltage at the collector rings. The conditions for rotary converter compounding are therefore, a series winding on the field and inductance in the line between the generator and the converter. The series winding does not directly increase the direct-current voltage but acts indirectly through the inductance.

## A Low Record Rate for Electrical Energy

The city of Winnipeg, Manitoba, has established rates for commercial electric service that seem destined to outclass any efforts for low charges on the part of municipalities in the United States, including Pasadena, Calif., which for the past few years has practically held the record for a minimum consumption charge. With a municipally owned hydroelectric power plant on the Winnipeg River, the city has made a base rate of 3⅓c. per kilowatt-hour, with proportionate reduction for various classes of service.

The plant has a rated capacity of 32,000 hp., with available water power for the generation of about twice this amount. The power plant, transmission system (77 miles long), distributing lines and terminal station, were completed in October, 1911, at a cost of approximately $3,250,000. With this total investment, and a population of about 175,000, the city is earning suitable returns with the following rates of service:

Electric lighting: Base rate, 3⅓c., for store, factory and residence use. Discounts on bills of $50, or more, per month, ranging from 10 to 60 per cent. Minimum rate for residence lighting per month, 50c.; for business lighting, $1.

Electric heating and cooking, for domestic service: A separate meter is installed, with a rate of 1c. per kilowatt-hour. Minimum charge of 75c. per month.

Electric power: Rates range from 3⅓c. to 0.8c. per kilowatt-hour, the bills being subject to discount as noted.

# LETTERS

## Pilot Lamps

In some small isolated electric stations, the opening of the main circuit-breakers causes the entire plant to be plunged in darkness. In such cases considerable time and trouble can be saved by a slight change in the wiring of the lamps on the switchboard. By connecting one or two lamps directly to the generator leads (as is usually done in the larger stations), they cannot be affected by the opening of the main circuit-breakers, and sufficient light is left to enable the attendant to operate the board.

Not long ago a 600-kw. plant in a manufacturing establishment was shut down by a short-circuit, every breaker being opened. It took 15 min. to find a torch or lantern by which to see the meters and ascertain conditions at the switchboard before restoring the current to it. Meantime the engine room was in total darkness, and the running engines made it dangerous to move about.

Had a few or even one of the switchboard lamps been connected directly to the generator leads, current could have been restored to the board immediately.

I. C. CHAMBERLAIN.

Paterson, N. J.

## Rebabbitting a Large Bearing

A short time ago we had a main bearing burn out on a direct-connected 500-kw. direct-current generator. As we had already experienced the high cost of having a similar bearing rebabbitted at a local shop, we decided to do the work ourselves.

This unit was the first of an incompleted installation and was already running two cars on a short piece of track, which depended upon it entirely for power. Consequently it was very essential to have the machine running as soon as possible. In order to remove the bearing, it was necessary to raise the armature and flywheel with the shaft. This was accomplished by means of two 25-ton jacks under the shaft and one 50-ton jack under the flywheel. The bearing was removed during the night and was ready for the shop by seven the next morning.

We had no metal mandrel nor means for turning up a wooden one and the best substitute was a short piece of pipe about 14 in. in dimaeter. This was brought to the proper size, the shaft being 15 in. in diameter, by wrapping pieces of asbestos paper around it, this paper also acting as a very good heat insulator. The bearing was in four pieces, a top and bottom and two quarter wedges, one piece being babbitted at a time in the following manner:

The piece to be babbitted was stripped of all old babbitt and heated to a very high temperature. It was then laid on a level floor; thin strips, about ¼ in. thick, cut from an old belt, were laid at the ends to obtain the proper thickness of babbitt and the pipe rested on these. The babbitt was then heated in two pots and poured in from both sides of the bearing. As the metal shrunk slightly upon cooling, it was necessary to keep pouring in a little metal until the space was entirely filled, and no more metal could be poured. After being scraped and the oil grooves cut, the bearing presented a very good appearance. The job was completed by two men in 9 hr., as against 3 days required in the former case and at about ⅔ less cost. The bearing was replaced the same evening and outside of a slight scraping the next day, has proved entirely satisfactory.

Dover, N. J. J. M. BURNS.

## Wattmeter Connections

Referring to Mr. Crateau's wattmeter connections in the issue of Apr. 23, I would submit the following explanation:

Meter No. 1 is apparently connected properly. Meter No. 2 has both current coils connected into the same phase. This is incorrect and will produce one of two possible results. Upon increase of field excitation the meter will slow down, stop and reverse; or will speed up rapidly, reaching a maximum speed of 173 per cent. of normal, depending on the phase into which the current coils are connected.

Of course, the solution is to connect the current coils into their proper phases. It should be impossible for meter No. 1 to indicate over half load. The synchronous motor, at full load and 50 per cent. power factor, will require somewhat less than 250 amperes per phase. This would require a current transformer of ratio 250: 5 to give full load indication on the meter. He is using one having a ratio of 500: 5 which naturally reduces the meter indication one-half.

Meter No. 2 is rated at 150 volts at five and ten amperes. With the potential transformer he is now using, having a ratio of 20: 1, he will get 110 volts, which is so much below the meter rating that I doubt if the meter will give dependable results. The meter should be used with a transformer of a ratio of 15: 1.

The current coils should have a ratio of 250: 5 and the five-ampere current windings should be used.

If these changes are made, the meter should check.

H. R. BODEMÜLLER.

Necaxa, Puebla, Mexico.

# Gas Power Department

**Worth-while gas-engine and producer information treated in a way that can be of practical use**

## Bituminous Producers for Power*

By C. M. Garland

In the development of the power producer for the gasification of fuels containing above 12 per cent. volatile matter, the manufacturers at an early date divided on the question of the method of handling this troublesome constituent and proceeded with their developments along two diverging lines. In one they sought to convert the condensible combustible constituent of the volatile matter into fixed combustible gases by drawing this product through either the whole or part of the incandescent fuel remaining after volatilization; in the other to separate the condensible portion from the permanent gases after these had left the generating chamber. The former group turned their energies to the development of down-draft and double-zone arrangements, while the latter directed their efforts toward the production of updraft producers and tar-handling apparatus. It has been the privilege of the writer to observe the operation of a number of plants of the latter type and to analyze the results of the operation of others.

### Description of Apparatus

The plants belonging to the latter class are of two general types, suction and pressure, while the apparatus is essentially similar in each, varying principally in size and general arrangement. Fig. 1 shows a vertical section through the producer, scrubber and the water-sealed gas main, which is a characteristic arrangement for plants up to about 1000 hp. The pressure plant differs from the suction plant by the addition of a fan-type blower and a regulating holder. In the earlier plants the latter served as a large storage reservoir with capacity sufficient to keep the engines operating from 3 to 10 min. It was also thought that this large capacity tended to insure greater uniformity in the composition of the gas, so that the holders were placed in series with the engine and scrubbers. In more recent plants the size of the holder has been greatly reduced and in most cases floats on the line so that the gases do not pass through it. This change has been brought about partly because a large storage capacity is not required and in many places is undesirable. Also the mixing effect of the gases in the holder has proved a fallacy.

From Fig. 1 it will be noted that the producer *A* is of the water-sealed type, with a central blast *B* and superimposed vaporizer *C*. The gases pass direct from the producer to the scrubber *D*, which is provided with a vertical baffle *E*, from the scrubber to the water-sealed main *F*, and from this to the tar extractor *G*. The latter is of the centrifugal type and is illustrated in detail in Fig. 2.

Referring to Fig. 2, the gas enters at *A* and meets a stream of water at *B*. The mixture flows upon the rotating vanes *C* and is discharged into the stationary vanes *D*. The water and a portion of the tar are thrown out against the casing *E* and follow this around to the drain *F* which discharges into the seal pit *G*. The gas leaving the stationary vanes *D* reenters the rotating vanes *H* on the opposite side of the disk *I*. The gas here meets a stream of water from the nozzle *J* moving in the direction opposite to the gas which removes the remaining tar. The gas leaves at *K*. The extractors are usually designed to deliver the gas under a low pressure and are built in more than one stage for the larger powers.

A portion of the steam generated in the superimposed vaporizer *C*, Fig. 1, is used to saturate the blast. The amount supplied is indicated by the temperature shown by the thermometer *H*. The steam pressure on the vaporizer is maintained constant by the back-pressure valve *J*, while the air pressure on the main *K* is also constant. The valve *L* is therefore used to vary the amount of steam delivered to the blast. The butterfly valve *M* connects with the holder and regulates the amount of blast delivered to the producer. Changes in the position of this valve do not affect the relative proportions of air and steam. In more recent plants a thermostat located in the blast pipe operates a throttle valve in the steam line from the vaporizer in order to maintain a constant temperature of the blast.

The fuel is fed to the producer by the hand-operated centrifugal charging device *N*, which insures a very even distribution.

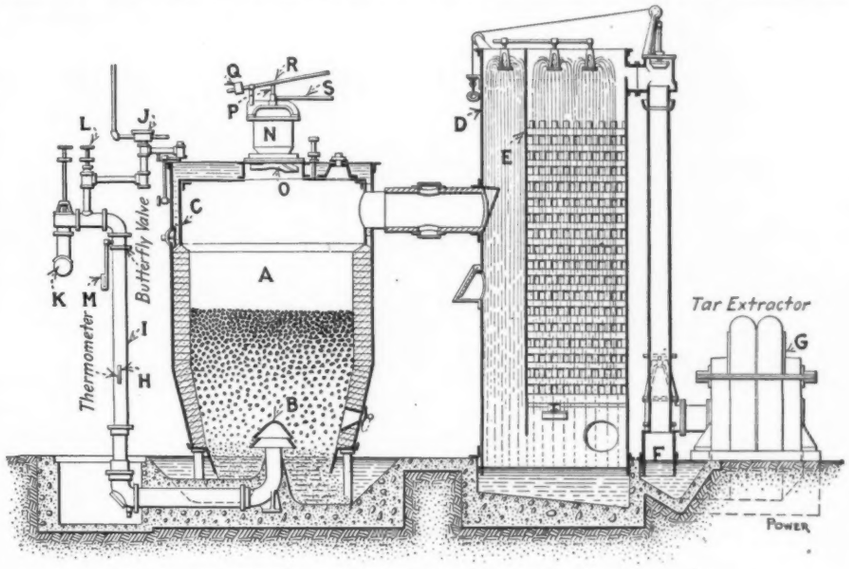



Fig. 1. Bituminous Producer, Scrubber and Tar Extractor

This consists of the hopper provided with a ribbed charging bell *O*, which is rigidly mounted on the shaft *P* and held against its seat by the counterweight *Q*. When the fuel is charged the bell is lowered by the arm *R* and at the same time rotated by the arm *S*. Both arms are hand operated. After the fuel is charged, the counterweight *Q* causes the bell *O* to seat. A sliding cover closes the top of the hopper which prevents the escape of gas while dropping a charge of fuel.

### Thermal Efficiency

The efficiency depends to a certain extent upon the volatile matter. For fuels containing as high as 30 to 50 per cent. volatile matter, the thermal efficiency

*Excerpt from paper read at the spring meeting of the American Society of Mechanical Engineers.

based on the higher heating value of the gas is about 66 per cent., while the efficiency based on the effective heating value of the gas is ordinarily 5 per cent. lower than this, or 62.7 per cent. (exclusive of the power required to drive the tar extractor). Where the volatile matter does not exceed 20 per cent., the efficiency is somewhat higher.

The volume of gas generated per pound of coal depends upon the composition of the coal and the condition of the fuel bed. In a seven-day test on a producer plant using run-of-mine Pocahontas coal, the volume of the standard gas generated per pound of coal was approximately 71.5 cu.ft. For lignite the volume of standard gas varies between 36 and 40 cu.ft. per pound.

A large number of tests were made to determine the cleanliness of the gas delivered by the tar extractors, the results of which showed that the solid matter averaged about 0.0206 grain per cubic foot of standard gas. The determinations were made by drawing samples of the gas through three thicknesses of filter paper on which the solid matter was deposited. In most cases simultaneous samples were taken from the entering and exit sides of the extractor.

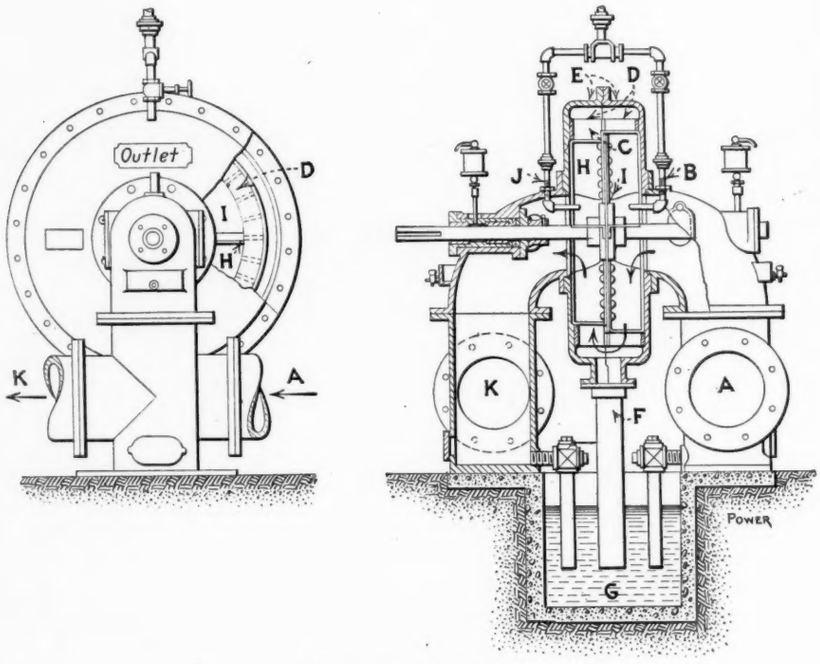



FIG. 2. TAR EXTRACTOR

### HANDLING THE TAR

In the earlier plants difficulty was experienced by the tar accumulating in the scrubbers and pipe lines, causing frequent shutdowns. In almost every case this trouble was due to lack of experience on the part of the builders in designing these parts, and to the operators who failed to take proper precautions and profit by their first troubles.

In so far as the yield of tar is concerned, there are but three objections that can be urged against it:

1. Loss in efficiency of the plant due to the removal of a combustible constituent from the fuel.
2. The expenditure of power in driving the tar extractor.
3. Difficulties in the disposal of the tar.

The magnitude of these items is fairly well known. The loss in thermal efficiency varies from 12 per cent. for fuels containing from 15 to 20 per cent. volatile matter to 17 per cent. for fuels containing above or near 30 per cent. of volatile matter. The power required to drive the tar extractor depends upon the nature of the tar produced. With lignites, which produce a thin yellowish tar resembling very nearly a heavy oil, the power required is at least 25 per cent. less than the amount required for bituminous coals. For bituminous coals this power varies from 5 per cent. of the power of the plant in a plant of 100 b.hp. to about 3.5 per cent. for a plant of 1000 b.hp.

As to the difficulties in the disposal of the tar there is in some instances a ready market for the tar product; in other cases it can be burned under boilers.

The usual method of handling the tar is to place the extractor over a pit containing water into which the mixture of tar and water from the extractor is discharged. The pit is arranged so that the tar may be skimmed into a barrel or receiver. Where a receiver is used it is provided with an air-tight cover, and when filled the cover is put in place and either steam or air is forced in under pressure; this in turn forces it through piping to the point of disposal. Where the tar is thick and heavy, it is necessary to provide the receiver with a steam coil to keep the tar in a fluid condition.

### PRODUCER PLANT COSTS

The cost of producer plants and of operating them are by no means fixed quantities, so that it is very difficult to give figures that are general and that can be safely applied to any and every case. Each plant requires individual consideration, but the following applies to the general case:

The first cost depends upon

1. The service or load conditions and the magnitude of the load. These determine the necessity for duplicate or spare apparatus and the number of units into which the plant should be divided.
2. The design of the producer. With a given fuel one type of producer may gasify 50 per cent. more fuel than another type, or one type may be capable of continuous operation, while still another may require a light load during the period of the removal of ash.
3. The method of generating steam for the blast; that is, whether or not the producer generates its own steam supply or requires that this should be generated in separately fired boilers, either fired direct or exhaust fired.
4. The characteristics of the fuel, including the percentage of ash. With low ash a plain water-sealed producer is satisfactory, but with ash above 12 or 15 per cent. a rotating table and cone bottom become desirable.
5. The scrubbing apparatus required, which depends to a large extent upon the volatile matter in the coal.
6. The method of handling the coal and upon local conditions.

The operating costs are intimately connected with the first cost and depend upon

1. The character of the fuel, some fuels requiring more labor than others.
2. The design of the producer.
3. The amount of ash.
4. The coal-handling machinery.
5. Facilities for handling the tar.
6. Supervision and local conditions.

### FUTURE DEVELOPMENTS

The future for this type of plant is promising, as more economical results are now recognized as attainable, through improvements which tend to reduce the first cost of the plant and also the operating costs. These are an increase in the rate of gasification, a decrease in the power required to drive the cleaning apparatus, and utilization of waste heat. Increase in the rate of gasification has been made possible by a careful study of the effect of the distribution of the blast on the operation of the producer.

A number of years ago the writer demonstrated on a small anthracite producer in the mechanical-engineering

laboratory of the University of Illinois, that certain fuels could be gasified at rates as high as 40 lb. per square foot of fuel bed per hour without difficulty. Later while operating on lignite in Texas, which produced a very fine ash and caused considerable trouble in the ordinary central blast producer, the prime reason for the satisfactory gasification of one fuel at a very high rate of gasification and the failure in the gasification of another fuel at the same rate, was most clearly and forcibly demonstrated.

From this study and investigation it has become apparent that average fuels can be gasified at rates from 50 to 150 per cent. greater than the present rating of producers (9 to 10 lb. per square foot of fuel bed per hour), and with no increase in labor. This means a great reduction in the first cost of producer plants and also in the operating costs. Furthermore, the same principles produce the same results in large producers as in small producers, so that it is just as practicable to build a producer of large as of small diameter, while the labor per square foot of fuel bed required in the operation of the producer, the first cost, and operating costs are greatly reduced. A producer 9 ft. in diameter inside the lining, having an area of 63.6 sq.ft., requires less labor to operate than two producers 6 ft. in diameter (area 56.5 sq.ft.). It is, however, true that the gas from two smaller producers will probably be more uniform in quality than the gas from one large producer. The writer's experience would indicate that producers up to 15 ft. inside diameter are practical.

Utilization of the waste heat is an item that has received some attention in the past, but not as much as it warrants. As a rule, the average gas plant is extremely wasteful of heat. About 12 per cent. of the heat in the fuel is thrown away in the scrubber water, while about 60 per cent. is thrown away in the cooling water to the engine cylinders and in the exhaust.

## Testing Internal Combustion Engines

By Everard Brown

The efficiency of an internal-combustion engine is the ratio of the heat converted into actual work to the total amount of heat received by the engine. In a general way, the difference between the heat of combustion and that in the exhaust is the measure of heat turned into work which may represent the degree of efficiency without expansion losses. An efficiency so determined, however, is of but little value and must, to a large extent, be based upon assumed values. The heat of combustion is always variable, due to leakage, radiation, absorption, mixture of the charge, etc.

It is practically impossible to record accurately these temperatures, for the changes are usually so rapid that no reliable observation can be made; also the computed temperatures are, at best, only approximate and can be calculated only from the known heat values of the fuel constituents. This would no doubt be fairly accurate if the inert gases of previous explosions could be excluded, but herein lies the difficulty.

Therefore, it devolved upon the indicator diagram to show what is going on within the engine cylinder so far as combustion and expansion are concerned and to point out the proper adjustment of the valves. While the diagram is being taken it is essential that the engine run steadily and with no misfires, so that the true indicated horsepower will be recorded. The speed should be recorded simultaneously, but the fuel-consumption test should cover a longer period—say, five or ten minutes—because it is rather difficult to accurately determine the amount consumed in the short time required to take an indicator diagram. Then, by calculating the total fuel consumption for one hour and dividing this by the average indicated power, as shown by the diagrams, the economic rating of the engine may be determined.

Instead of taking diagrams, the actual horsepower may be found by using a brake, in which case a continuous run under good conditions is necessary. One of the best ways to determine the power of a combustion engine is by connecting it to an electric generator. The amount of power in kilowatts can easily be found, and corrected for the loss of efficiency in the generator. This method also affords an easy means of determining how to develop more power and produce smoother operation. The element of speed must enter into any test, no matter how made, as it is important in establishing a rating. Much more elaborate tests can be made on engines of this type, but they are much finer and more delicate and require expert performance; such tests, however, hardly justify the trouble involved. For ordinary commercial purposes it has been found that the indicator diagram or the electric generator and, in some cases, the brake will answer all purposes. The horsepower so determined when compared with the actual amount of fuel consumed will give quite accurate data as to fuel economy, but it should always be borne in mind that before starting any test the cooling water should be allowed to flow until it attains a constant temperature.

By July 1 all the Canadian Pacific trains on the Field-Kamloops division will be hauled by oil-burning engines. This is the heaviest road in the Rockies and the use of oil will guard against forest fires.

# CORRESPONDENCE

## Troublesome Bearings

The bearings on one of our gas engines gave considerable trouble when the machine was new and it was very difficult to keep the engine running the first few months.

It is a center-crank tandem four-stroke-cycle machine having a belt wheel on one end of the crankshaft and a balance wheel of the same diameter on the other. The three bearings, one on either side of the crank disks and one between the spiral two-to-one gear and the belt wheel, are of two-piece construction. The lower halves are cast in the engine frame and the caps are set on at an angle of about 30 deg. with the horizontal. The only adjustment is to take off the caps and put in or take out liners.

These bearings seemed to contain very inferior babbitt and once they began to heat, it would tend to pull over and fill the oilways. We refitted the caps several times but this did not put back the babbitt that had been taken from the bottoms.

Early one Sunday morning we jacked up the shaft, made a runway of timbers for the wheels and rolled them out of the way. We could do little more, however, than scrape out the roughest places as it was impossible to roll the shaft in and out often enough to get a good fit in the limited time. We put things together again and found that conditions had improved somewhat, so an arbor was ordered the same size as the shaft, and another Sunday spent scraping and fitting the bearings. We got the engine together again by evening. It turned very stiff when barred over to the starting position, but after exhausting nearly all the air in the receiver it finally started.

We then discovered that our troubles were not over, for in scraping the bearings the shaft had been lowered so the teeth of the spiral two-to-one gear meshed too deeply, and it soon began to smoke. It meant either to lift out the shaft again, take out the layshaft and scrape the bearings until the gear meshed correctly, or file off the ends of the spiral teeth until they cleared. We chose the latter.

It was tedious but we did not have to take off much and about 10 p.m. were ready to start again.

Everything seemed in good shape except that there was a click about the crank. This we failed to locate that night, but later found it was caused by the tip end of the crank brass grazing the bottom of the crankcase. It was remedied by cutting the corner of the brass with a cold chisel. These bearings gave no further trouble for some time, but as we could not let the shaft any lower, as soon as they were out of true we had to rebabbitt them.

Earl Pagett.

Coffeyville, Kan.

# Heating and Ventilation

**Considered as power-plant problems. Layout and operation of systems and apparatus**

## Hot Water and Corrosion

Following are excerpts from a paper on "Hot Water Troubles" read by George C. Whipple before the American Water Works Association. The paper deals specifically with house heating, but that part of it discussing corrosion may interest engineers in charge of hot-water heating systems or hot-water service for house use.

According to the modern and generally accepted theory, corrosion of iron by water and formation of iron rust require first, presence of hydrogen ions in the water; second, presence of dissolved oxygen. Hydrogen ions are electrically charged atoms of hydrogen. All acids form them by dissociation. Whenever they are present in solution, that solution possesses acid properties. They attack metallic iron, which is dissolved in a ferrous condition. The oxygen dissolved in the water then oxidizes this ferrous iron and iron rust is formed. Under certain conditions this precipitates at once. Under others it apparently exists in a colloidal state; that is, an extremely finely divided state with its particles electrically charged, and precipitates only when this charge is neutralized. Very little is known about this phenomenon.

Iron naturally tends to dissolve in water as some hydrogen ions are always present. Pure water, therefore, by its dissociation acts as a weak acid. Even the purest distilled water splits up, or dissociates some of its molecules into hydrogen ions and hydroxyl ions. Distilled water therefore acts as an acid. Iron will be dissolved, and rust will form if oxygen is present. Whatever increases the hydrogen ions in water increases its corrosive power. Acids do this to a marked degree. Whatever decreases the hydrogen ions reduces the corrosive power. Alkalis do this. When alkalis are ionized, the hydroxyl ion is formed, and its electrical charge opposing that of the hydrogen ion neutralizes it.

A further conception of the phenomenon of iron rusting is that often referred to as "the electrolytic theory of corrosion." According to this a battery action takes place in the water and an electric current is set up between the metallic iron at one spot and some other metal or impurity at a neighboring spot. This action requires that the water be a conductor; it must contain electrically charged ions, and the higher the conductivity the greater the current. As a result the hydrogen ions give up their charge of electricity to the iron, which goes into solution, while gaseous hydrogen collects on the metal. As this gaseous hydrogen is a nonconductor, the iron, becoming covered with a film of it, is polarized, so that after a time the action ceases. Whatever removes the hydrogen from the metal depolarizes it and restores the action. Oxygen present in water does this, as it unites with the hydrogen to form water. Circulation of water containing oxygen, whether brought about by mechanical agitation or by thermal currents, also tends to remove the hydrogen. Oxygen therefore aids the corrosion of iron in two ways, by depolarizing it and by oxidizing the iron that goes into solution.

Presence of other metals also affects corrosion by increasing the difference of potential, and therefore the strength of the electric currents. This is termed "galvanic action." The metals act differently in regard to the direction of the currents between them and iron. Some cause the positive current to flow toward the iron and some retard it. The common metals and hydrogen are arranged in the following order of what is called the potential series: aluminum, manganese, zinc, iron, nickel, tin, lead, hydrogen, copper. Each tends to protect any other below it in the series from going into solution, but in doing so tends itself to dissolve. Thus zinc protects iron, but copper acts oppositely, and increases the solution of iron. Weston has shown recently by experiments on tin-lined lead pipe that the tin does not prevent the lead from dissolving. With two metals present, whatever increases the electrical conductivity of the water increases the corrosion of one metal or the other.

Corrosion and rusting require not only presence of the hydrogen ion, but presence of oxygen. It has been proved that where the hydrogen ion is present the rusting is proportionate to the concentration of the oxygen. The more oxygen, therefore, the greater the rusting. Generally speaking, hot water contains more than enough oxygen to oxidize the iron dissolved and probably the increased corrosion attending increased amounts of dissolved oxygen is due to its action as a depolarizer.

Surface waters used for public supplies are usually saturated with oxygen. Oxygen's solubility decreases as the temperature rises. Near the freezing point water dissolves about twice as much oxygen as at summer temperatures. The solubility decreases according to a regular curve and at the boiling point becomes nil.

The solubility of oxygen is also affected by pressure and increases directly with it. Water under two atmospheres pressure will hold twice as much oxygen as water under a pressure of one atmosphere. The solubility of oxygen in water at different temperatures and pressures is shown in the accompanying table.

SOLUBILITY OF DISSOLVED OXYGEN IN DISTILLED WATER AT DIFFERENT TEMPERATURES AND PRESSURES, PARTS PER MILLION

| | Water Pressure, Lb. per Sq.In. | | | | | |
|---|---|---|---|---|---|---|
| | 0 | 20 | 40 | 60 | 80 | 100 |
| | Pressure in Feet of Water | | | | | |
| Temperature, Deg. F. | 0 | 46.2 | 92.4 | 138.6 | 184.8 | 231.0 |
| 32.0 | 14.70 | 34.7 | 54.7 | 74.7 | 94.7 | 114.7 |
| 33.8 | 14.28 | 33.7 | 53.1 | 72.6 | 92.0 | 111.3 |
| 35.6 | 13.88 | 32.8 | 51.6 | 70.6 | 89.4 | 108.1 |
| 37.4 | 13.50 | 31.9 | 50.3 | 68.7 | 87.0 | 105.2 |
| 39.2 | 13.14 | 31.0 | 49.0 | 66.8 | 84.7 | 102.6 |
| 41.0 | 12.80 | 30.2 | 47.7 | 65.1 | 82.5 | 99.9 |
| 42.8 | 12.47 | 29.4 | 46.4 | 62.4 | 80.3 | 97.2 |
| 44.6 | 12.16 | 28.7 | 45.3 | 61.8 | 78.2 | 94.8 |
| 46.4 | 11.86 | 28.0 | 44.2 | 60.3 | 76.3 | 92.5 |
| 48.2 | 11.58 | 27.3 | 43.2 | 58.8 | 74.6 | 90.2 |
| 50.0 | 11.31 | 26.7 | 42.2 | 57.5 | 73.0 | 88.1 |
| 51.8 | 11.05 | 26.1 | 41.2 | 56.2 | 71.3 | 86.1 |
| 53.6 | 10.80 | 25.5 | 40.3 | 54.9 | 69.6 | 84.2 |
| 55.4 | 10.57 | 24.9 | 39.4 | 53.7 | 68.0 | 82.3 |
| 57.2 | 10.35 | 24.4 | 38.5 | 52.6 | 66.6 | 80.6 |
| 59.0 | 10.14 | 23.9 | 37.8 | 51.6 | 64.5 | 79.0 |
| 60.8 | 9.94 | 23.4 | 37.1 | 50.6 | 64.0 | 77.5 |
| 62.6 | 9.75 | 23.0 | 36.4 | 49.6 | 62.8 | 76.0 |
| 64.4 | 9.56 | 22.6 | 35.7 | 48.6 | 61.6 | 74.6 |
| 66.2 | 9.37 | 22.2 | 34.9 | 47.7 | 60.4 | 73.1 |
| 68.0 | 9.19 | 21.7 | 34.2 | 46.8 | 59.2 | 71.7 |
| 77.0 | 8.35 | 19.7 | 31.1 | 42.4 | 53.8 | 65.1 |
| 86.0 | 7.60 | 17.9 | 28.3 | 38.6 | 48.9 | 59.2 |
| 95.0 | 6.90 | 16.3 | 25.7 | 35.1 | 44.4 | 53.8 |
| 104.0 | 6.18 | 14.6 | 23.1 | 31.4 | 39.8 | 48.2 |
| 113.0 | 5.50 | 13.0 | 20.5 | 27.9 | 35.5 | 42.8 |
| 122.0 | 4.82 | 11.4 | 17.9 | 24.5 | 31.1 | 37.6 |
| 131.0 | 4.18 | 9.9 | 15.6 | 21.3 | 26.9 | 32.6 |
| 140.0 | 3.56 | 8.4 | 13.3 | 18.1 | 22.9 | 27.7 |
| 149.0 | 3.00 | 7.1 | 11.2 | 15.3 | 19.3 | 23.4 |
| 158.0 | 2.50 | 5.9 | 9.3 | 12.7 | 16.1 | 19.5 |
| 167.0 | 2.05 | 4.8 | 7.6 | 10.4 | 13.2 | 16.0 |
| 176.0 | 1.66 | 3.9 | 6.2 | 8.4 | 10.7 | 12.9 |
| 185.0 | 1.30 | 3.1 | 4.8 | 6.6 | 8.4 | 10.1 |
| 194.0 | 0.95 | 2.2 | 3.5 | 4.8 | 6.1 | 7.4 |
| 212.0 | 0 | | | | | |

When water saturated with oxygen is heated, the pressure remaining the same, oxygen is liberated, as is also the dissolved nitrogen. When a glass of cold water stands in a warm room, bubbles of air collect on the glass. For supersaturation to occur when water is under pressure the temperature must be raised considerably and the greater the pres-

sure the higher must the temperature be raised. For example, water just above the freezing point contains 14.5 parts per million of dissolved oxygen. If placed under 40 lb. pressure per square inch the temperature would have to be raised to 135 deg. F. for supersaturation to occur, and if the pressure were 100 lb. it would be necessary to raise the temperature to 170 deg. F. When heated above the saturation point, part of the air goes out of solution. This occurs to some extent in domestic hot-water systems. Rumbling of kitchen boilers is common where the tank system is used and the pressure is low. The liberated air ultimately escapes through the expansion pipe or the opened taps. Corrosion in feed-water heaters has been commonly noticed to increase with the temperature of the water up to a point somewhere between 170 and 190 deg. F., and above that to decrease.

Galvanized-iron or steel pipes are largely used in hot-water heating systems. They do not often corrode seriously, because the water is used over and over and the oxygen becomes used up.

The more rapidly water circulates through a hot-water system the greater is the pipe rusting, because the circulation prevents hydrogen accumulating on the metallic iron, that is, prevents polarization. This, with the mechanical removal of the oxidized iron, increases the corrosion.

Laboratory experiments made by various authorities have shown relatively little difference in the corrosion of wrought-iron and steel pipes. In tests made by immersing samples in strongly acid solutions, steel pipes sometimes have shown up better than wrought iron, and sometimes not as good. The laboratory data on this point are inconclusive. It seems to be common experience, and certainly the prevailing idea among engineers that wrought-iron pipes resist corrosion by water better than steel pipes. Whether this is due to inherent differences between the two metals, or to more frequent imperfections in the manufacture of steel cannot be determined readily from the data in hand. Homogeneity is important in preventing corrosion, and apparently steel pipe suffers more from lack of it than wrought-iron pipe. From practical experience, most engineers prefer the best grades of wrought iron; but probably the better grades of steel pipe are superior to the poorer grades of wrought iron.

Much depends upon the thoroughness of the galvanizing. Pure zinc affords the best protection. The coating should be sufficiently thick and so applied as to thoroughly cover the pipe. The old-fashioned dipping process gives best results.

If the above mentioned theories of corrosion are correct, the logical methods for preventing rusty hot water would be reducing the hydrogen ions in the water or increasing the hydroxyl ions, getting rid of the dissolved oxygen, reducing the temperature, pressure and circulation, and using good quality pipes selected with reference to the nature of the water. Practice can follow theory to a certain extent.

Doubtless the most effective way to avoid rusty hot water is to use brass or some metal other than iron or steel for the hot-water pipes and boilers. This increases the installation expense, but with very soft waters is advisable. Brass, if used, should be properly alloyed and well annealed; proper fittings also should be used.

If wrought-iron or steel pipes are used they should be of the best quality and well protected by galvanizing with pure zinc applied by dipping. Experience indicates that wrought-iron pipes of the best grade resist corrosion better than steel pipes, but so many exceptions have been found that this cannot be considered definitely established. Poor grades of both steel and iron pipe are to be avoided. Reforms are needed in the manufacture and methods of branding and selling smaller-sized pipe for use with hot water.

In domestic hot-water supplies it is not feasible to prevent water circulation in the pipes, nor is this desirable, as the circulating system has several distinct advantages. The hot-water pressure must depend chiefly upon existing conditions, but in designing a system where red-water troubles are feared, low pressure should be favored. Probably the temperature of the hot-water supply often is maintained higher than necessary for domestic uses, and then red water could be materially reduced if excessive heating were prevented by using an automatic control.

Neither is it feasible nor desirable to remove the dissolved oxygen from a public water supply, except for boiler waters, when the results are said to be beneficial. Nothing hinders its being done for hot-water installations in large buildings, as apartments, hotels and office buildings, where large numbers of taps are supplied from a common source. By first heating the water to, say, 175 to 195 deg. F., and then raising it to an open elevated tank, much of the dissolved oxygen and carbonic acid as well would be liberated and its corrosive power materially diminished. More complete removal might be obtained by using a closed storage tank with a partial vacuum. Whether this would produce better results than a regulated low temperature is yet to be determined.

Most effective in preventing rusty hot water, next to avoiding iron and steel pipe, is to reduce the hydrogen ions in the hot water, or, what is equivalent, increase the hydroxyl ions. This practically means that the public water supply should not be too soft. Experience seems to indicate that the alkalinity should be at least 10 or 15 parts per million. The higher the alkalinity the less the chance of rusty hot water.

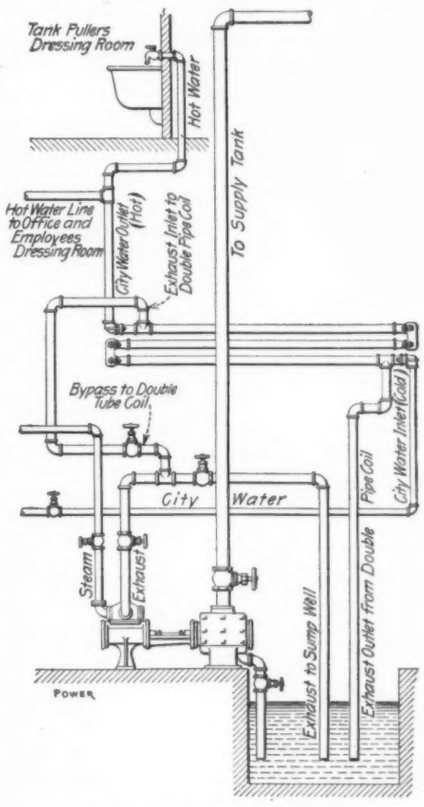
Public water supplies high in organic matter and low in alkalinity may be advantageously hardened by adding a small quantity of lime, say 10 or 15 parts per million. This practice has long been common in England.

With hard waters, where the hardness is due to carbonates, practically no precautions need be taken, as the hardness itself seems to be sufficient to prevent rusty water troubles.

# LETTERS

## Hot Water Kink

I once worked in a plant where the management could not see its way clear to provide hot water for the help, and so the man in charge had to get up something to stop the kicking. We rigged up a three-pipe section of a double-tube




ARRANGEMENT OF PIPING

ammonia condenser so that the exhaust steam from the sump pump could be passed through it. The city water was passed through the inside pipe in a direction opposite to the steam.

No pressure can be built up in the coil as the exhaust steam cannot heat the water enough for that. If there is any call to shut off the steam from the coil, this can be readily done and the steam exhausted into the sump. If the water should get too hot, the two valves

can be operated so that half of the steam could be passed directly into the sump and the balance through the coil.

EDGAR G. SCHINDLER.

Roxbury, Mass.

## Gas Fired Heating Boilers

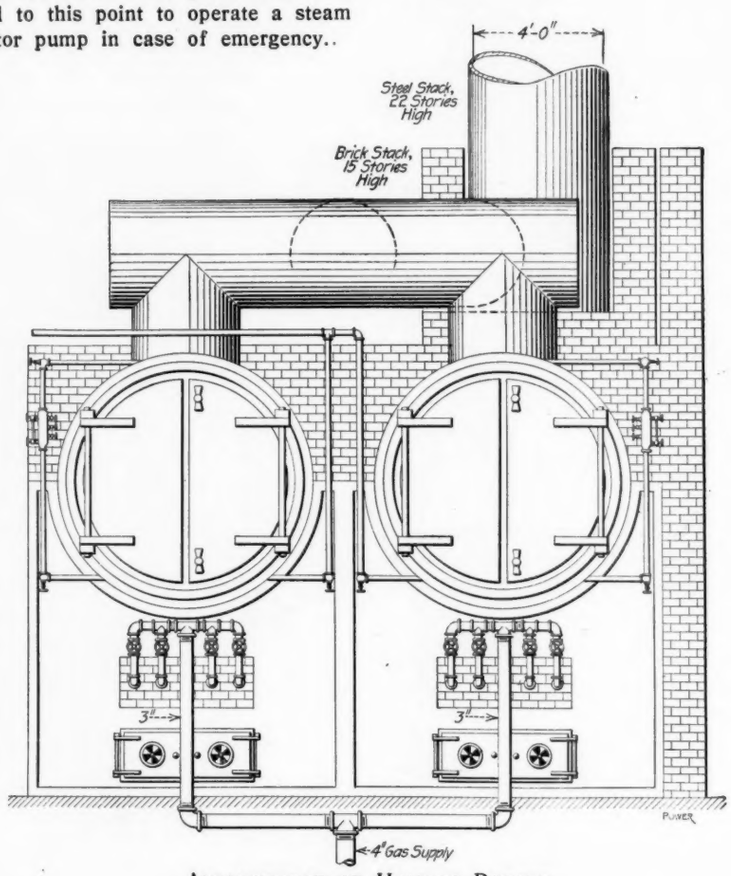
In a 14-story office building there are two 54-in. by 16-ft. fire-tube boilers used for heating. They carry 40 lb. steam pressure and steam is furnished to the heating system at 5 lb. pressure by a reducing valve. The safety valves are set at 100 lb. and the pressure can be raised to this point to operate a steam elevator pump in case of emergency..

Each boiler is set up and equipped identically the same, and each is free from scale or soot. Yet boiler No. 2, next the wall, uses 30 per cent. more gas than the other under the same conditions. Only one is used at a time. To do the same work No. 1 boiler requires two burners and for No. 2 three burners must be operated.

The sketch will give some idea of the layout. Will someone explain the reason for this?

L. M. JOHNSON.

Glenfield, Penn.




ARRANGEMENT OF HEATING BOILERS

The boilers are exactly alike and are set up and piped alike. They are fired with natural gas by means of four Kirkwood gas burners under each boiler. The gas is supplied through a 4-in. pipe with 3-in. branches to each boiler leading to a set of burners attached to a 2-in. manifold by 1¼-in. pipes. Each boiler has a checkerwork baffle wall just in front of the bridgewall. Each baffle wall is laid up in the same way and at the same distance from the burners.

The smoke uptakes rise from the front of each boiler and connect to a common breeching, from the center of which the flue runs to the back of the boilers, where with a 45-deg. turn it enters the stack which rises 22 stories above the boiler room to the top of the adjoining building. The damper is in the horizontal flue.

## Siphon on Return

The chief requirement of this system is a supply of water under pressure (about 60 lb. in this case) to operate the water siphon which is used instead of a pump, to create a vacuum and remove the condensation; this it does very satisfactorily.

It has been in operation for two winters and has given very little trouble. The system heats a pattern shop with two 220-ft. overhead coils of 1¼-in. pipe, one wall coil of 210 ft. of 1¼-in. pipe, one glue pot, a lumber-drying room having 396 ft. of 2-in. pipe laid on the floor, a pipe fitter's shop with two wall coils containing 270 ft. of 1¼-in. pipe each, a repair shop having two wall coils with 180 ft. of 1¼-in. pipe each and one with 80 ft. of 1¼-in. pipe; a water heater for furnishing hot water to a bath and wash room, one radiator in an office and three in a small laboratory building.

The underground mains were laid in a wooden trough packed with mineral wool and covered with corrugated metal arches as shown in the sketch.

The siphon was made of ordinary pipe fittings. The discharge is connected to the sewer, as with no separator on the line, the water is slightly mixed with oil.

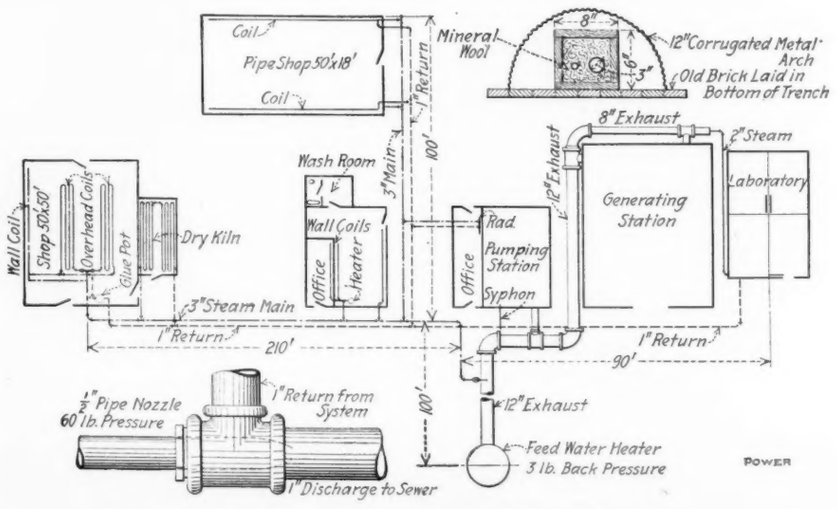
The buildings are quite a distance from each other, as shown in the sketch. The system kept all the buildings heated to about 70 deg. F. in the coldest weather.

E. G. GERBER.

Middletown, Ohio.

"Supposing," said the examiner, "you had renewed the manhole gaskets, had tightened up the nuts on the manhole dogs and had got 125 lb. of steam, what would you do if a dog came off and the handhole plate fell in?"

"I'd go in after it," answered the candidate. "Any plate that could fall in against a pressure of 125 lb. would be worth going after."




LAYOUT OF SYSTEM ON WHICH SIPHON WAS USED

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# POWER

## Water in the Low-Pressure Cylinder

In another column is told very lucidly how the low-pressure cylinder of a compound engine may be wrecked by water, notwithstanding the impossibility of pulling it over from the condenser. Some years since POWER recorded a serious accident of this kind where the engine had been running light for a considerable time and the end of the drip pipe from the receiver was submerged in a drain. The arrangement of the piping shown in the illustration accompanying the present article is not above criticism, but the drawing was made from an existing plant and there are many others to be found which are no better.

It is a deplorable fact that there are engines in daily operation supplied with steam through long lines of piping in which there is no separator. There are engines running without relief valves on the cylinder. To relieve a cylinder of a large dose of water in the limited time available would require a relief valve of prodigious proportions, but ordinary relief valves do prevent damage when the water comes in limited quantities and might furnish an admonition against a gathering accumulation. The boilers should be kept clean and watched for signs of priming.

There are feed-water regulators to be had which will prevent the carrying of too high a water line and a large separator near the engine will pay for itself in sustaining the initial pressure and the reduction of the baleful effect of water in the cylinder aside from its liability to cause a wreck. It goes without saying that the receiver trap should be a thoroughly reliable one and should be watched with vigilance.

A trap which will discharge from a vacuous space into the atmosphere may be used or it might be possible to discharge it to the condenser if provision were made for free discharge when the condenser is not in operation.

Engineers who are sensible of liability to accident from the lack of these precautionary appliances or from faulty arrangement of the receiver and piping, should call the attention of those in authority to the existing conditions, explain just why they are dangerous and put in a requisition for the needed changes and appliances, so that they may be upon record as having recommended means of prevention if an accident does occur.

## Standard Flanges

There is war between the societies and the manufacturers of flanges and flanged fittings.

In the fall of 1911 a joint committee of the National Association of Master Steam and Hot Water Fitters and the American Society of Mechanical Engineers recommended a schedule of standard-weight and extra-heavy flanged fittings and flanges, tabulated in our issue of Mar. 19 of this year. It has since been approved and recommended by the American Society of Heating and Ventilating Engineers and by the Bureau of Standards of the United States Government.

But the manufacturers of flanges and flanged fittings will have none of it. They claim that it was sprung upon them without consultation and adequate discussion, and, through a committee, have issued an injunction or warning to engineers not to specify or order fittings by the so called 1912 Standard. They say that this standard has not been accepted as final by the manufacturers and will not be accepted until certain necessary revisions have been made, "to meet the practical requirements of all concerned."

The committees claim that the coöperation of the manufacturers was sought, that every opportunity was offered to them to discuss the changes necessary to bring about uniform as well as safe practice, both before the report was submitted and while it was before the several societies for discussion, but that the attitude of the manufacturers was such as to discourage any change, and that

it is only after the schedule has been adopted and promulgated and they are receiving specifications under it, that the manufacturers have shown any disposition to take the matter seriously.

The desirability of a uniform standard is undeniable. One should be able to send to a dealer and get a flanged fitting which will fit into a job without having to look up the history of that which is to be displaced and the representative of the same manufacturer or have one made to order. One should not have to make a separate set of drawings and calculations for the same job, according as one or another manufacturer is to furnish the flanges and flanged fittings. A 10-inch tee should be of the same length and thickness and have the same bolt circle and number of bolts in whatever shop it may have been made. The desirability of a standard is too obvious and imperative to discuss, and its importance far transcends any consideration of inconvenience and expense which the manufacturers may be put to in bringing their patterns and catalogs into agreement. If a standard schedule, approved by those who specify and buy flanges and flanged fittings, be proposed and adopted, those manufacturers who accept this schedule and adapt their products to it will have an advantage which the others cannot afford to forego.

There has been no such uniform standard. With the exception of five manufacturers who have adopted what is known as the Crane Standard, each producer was a law unto himself. These five manufacturers think that their standard is good enough, better in fact than that of the societies, and that if uniformity is the consideration, a standard upon which so many are already working should have been adopted instead of something which will impose trouble and expense upon everybody. This schedule was, of course, before the joint committee when it made up its schedule and it will be interesting to examine the departures from it which the committee has recommended, which will be done in an early issue of POWER.

In the meantime the societies stand upon the schedule recommended by their committees and the manufacturers are trying to discourage engineers from using this schedule in their specifications. If they can point out faults in the schedule at this late day, they should do so and the schedule should be revised to correct any real defects, but some one schedule—the best schedule—should be universally adopted. Uniformity is of more importance than anybody's individual preference or interest.

## Foolish Central Station Arguments

The intelligence and reasoning ability of engineers seem to be questioned, judging from some of the central-station literature addressed to them.

It assumes a beneficent interest in the welfare of the isolated-plant engineer, and points out the way to avoid the heat of the engine room, the dust and dirt accompanying the handling of coal and ashes and the petty details of plant operation.

No real engineer would even think of retiring his plant in favor of a central station just because it is hot—he would put in a ventilating fan. A more flimsy excuse for putting productive machinery out of commission is inconceivable. Every isolated plant represents an investment of thousands of dollars. If it is properly operated the cost of producing a kilowatt-hour at the switchboard should be much less, if the plant is of any considerable size and is credited with the steam used for heating, than that at which a central station can produce, distribute and collect for the same electrical output.

How, then, can an engineer, having the interest of his employer in mind, advise the substitution of central-station service for the isolated plant?

It is an easy way of making the engine room the coolest part of the building, but what an inducement to offer to a progressive engineer!

Of what moment are the petty details as compared to the brain part of the job? Doubtless shutting down the power plant will eliminate all details relating to isolated-plant power generation and the engineer *will* have more time to attend to the rest of his job (if there is anything worth while left). How can adapting central-station service resulting in a greater yearly cost, make an engineer more valuable or his job bigger?

Such ideas are advanced for a purpose, but it would be as convincing to suggest that battles may be won by ordering the soldiers to retreat because of the danger, noise and dust, as to attempt to persuade an engineer that his best interests will be served by shutting down his plant to increase his comfort or save himself work.

## Analyzing the Exhaust Gases

For many years boilers were operated by rule-of-thumb methods; if the fire burned brightly and looked good to the experienced fireman the boiler was apparently being handled efficiently. Later, however, more scientific methods came into use. Engineers began to realize that there was such a thing as excess air, also that furnaces must be arranged so as to aid in more perfect combustion of the gases; each of these having an important bearing upon the efficiency of the boiler. Naturally the index to these conditions was the composition of the flue gases, and special apparatus was evolved for analyzing them. At first this was more or less of an experimental nature, but its use has now become so general that a boiler room is looked upon as incomplete unless equipped with means for analyzing the flue gases.

The operation of the gas engine seems about to undergo a similar change. Ordinarily the experienced ear of the operator, or indications of the switchboard instruments (if the engine drives a generator), are depended upon in regulating the mixture. This introduces a personal factor which, at best, is usually undesirable when unsupported by any other check. The natural place to look for such a check would be in the composition of the exhaust gases. Their analysis would show not only whether the engine was running on the proper mixture but would prove a valuable aid to making adjustments of the mixer. It also furnishes a means for accurately determining the heat wasted in the exhaust and thus permits calculating very closely the thermal efficiency of the engine.

Although certain steps have been taken along this line they have been, for the greater part, of a laboratory nature. Such work is very often necessary before making practical applications, but we venture to predict that the time is not far off when an Orsat apparatus will be just as much a part of the gas-engine equipment as it now is of the boiler room.

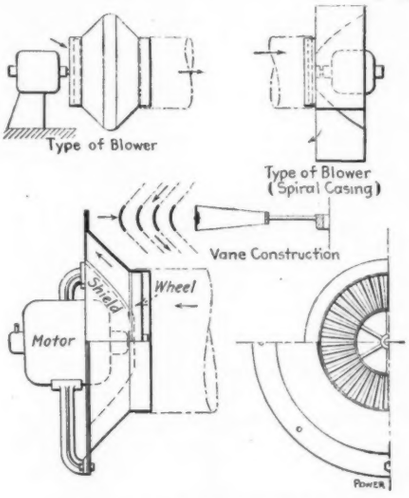
# Readers with Something to Say

**A letter good enough to print will be paid for. Ideas, not mere words, wanted**

## Axial Flow Turbine Fan

The wheel illustrated is 9½ in. in diameter and has 48 vanes tapered toward the center and curved in cross-section in stream-line form. The shield must be designed in spaced relation to the wheel, to prevent the center of the wheel working overloaded and to bring the center air up to the velocity of the gyration circle. This shield may be adjusted to or from the wheel to vary the load. No casing is required for operating it as an exhauster connected to piping.

In starting the wheel, a rarefaction is caused by the moving air on the face of the shield, which tends to draw air through the wheel axially. The resultant




DETAILS OF TURBINE FAN

of this and the centrifugal force gives the air a spiral whirl on leaving the wheel, with the greatest vacuum at the center.

The ultimate velocity of the air from the whole face of the wheel would come on the principal radius of gyration, or 0.7 of the wheel radius, but in operation a greater velocity is found, showing the air travels faster than the wheel. The blast area seems to be

$$\frac{\text{Area of face of wheel}}{3}$$

which is a larger area than that of centrifugal multivane fans of the same diameter. The power consumption compares well with other types of fans.

Features peculiar to this fan are that the inlet opening is the full diameter of the wheel; that the air enters normally to the plane of the blades, thus eliminating turns and the tendency to "skid" along the blade and pile up on the far side; that the entry edge of the blades may be curved forward to follow the stream line formation and eliminate impact, and that the wheel is lighter and better balanced for high speeds than others.

For the same diameter and speed this wheel gives half the pressure of a multivane centrifugal fan. If the wheel perimeter travel is, say, 2585 ft. per minute, then a point at the radius of gyration from the center will travel 0.707 of 2585, or 1828 ft. per minute; 1828 and 2585 ft. per minute are respectively the velocities of air giving ⅛ oz. and ¼ oz. pressures. Therefore, for the same pressures this fan would revolve 1.43 times faster than the multivane centrifugal fan (the power consumption is the same for a given volume) and is thus better adapted for turbine drive. In ventilating work a slow-speed fan for low pressures could be replaced with this smaller fan at a higher speed, giving the same volume at the same pressure and power consumption.

As a winnowing machine, shown in the illustration, the wheat or other material is thrown from the bowl in a whirl, the heavy product falling near the machine while the lighter is blown off; the operation reminds me of the old Spanish arrastra which was used by the Mexicans in mining.

I would welcome criticism from interested readers on this type of fan.

C. O. BRETHERICK.

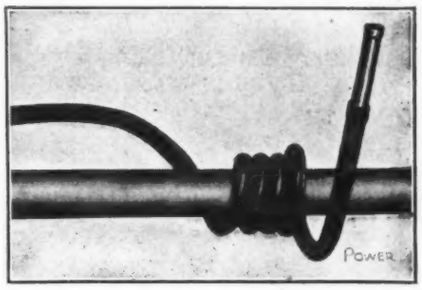
Seattle, Wash.

## A Strange Accident

The illustration shows a 1 1/16-in. countershaft, 11 ft. long, with shrunk collars on one end, coiled about a 4 7/16-in. main shaft. The peculiar mishap came from a sudden application of load to the countershaft, which caused the driving belt from the main shaft to slip from the pulley and wrap the shaft. As the belt wound up, it dragged one end of the countershaft with its hanger over, and all became firmly entangled in the arms of a large pulley on the main shaft. The hanger on the other end broke, and the end thus freed struck a girder overhead which held it until the countershaft was coiled tightly on the main shaft. When the coil had wound up enough to release itself from the girder, the revolving end tore up the floor planking within its range and created considerable noise and commotion.

To resume running the plant, it was necessary to saw off the projecting ends of the coiled shaft, and at the first shutdown the coil itself was removed.

To obtain the illustration the severed ends were wired in position and a wood roll of the same diameter as the main shaft was inserted to represent it.




SMALL SHAFT COILED AROUND LARGER ONE

The main shaft was turning at 270 r.p.m. so that the four convolutions were produced almost instantly, and anyone who has attempted to coil a small wire spring can appreciate the power necessary to produce the result above described.

H. E. OSGOOD.

Wilmington, Del.

## Losses in Uncovered Steam Pipes

We have 4826 lineal feet of steam pipe from 1 to 4 in. inside diameter in operation at the present time, the outside surface of which is exposed to the atmosphere.

Up to the present it has not been advisable to insulate many of these lines, due to changes in the manner of operation, which caused continual changing of lines or installing new ones. Although the loss due to condensation, etc., has been heavy, we believe it has been justified inasmuch as the covering would have been broken up and spoiled by handling from one line to another.

Our main lines (10 in. and 6 in.) are all insulated as well as some of the permanent smaller lines, and as the balance of our steam lines are now permanently located, and tight, they should be insulated.

According to publications of the American Society of Mechanical Engineers, the rate of radiation and condensation is 2.706 B.t.u. per square foot of radiat-

ing surface per hour per degree average difference of temperature inside and outside of the pipe.

Our average steam pressure is 100 lb. per square inch, or 115 lb. absolute; its corresponding temperature is 338.1 deg. F., its total heat 1188.8 B.t.u., its latent heat 879.8 B.t.u.

Based on an average atmospheric temperature for the year of 60 deg. F., our average difference is 278.1 deg. F. Taking the constant of radiation 2.706 to one decimal place, which is sufficient, we have

$$2.7\ B.t.u. \times 278.1\ deg.\ F. = 750.87\ B.t.u.$$

per square foot per hour in heat radiated or lost. This 4826 lineal feet of bare pipe has a radiating surface of 3626.1 sq.ft.

$$3626.1 \times 750 = 2{,}719{,}575\ B.t.u.$$

per hour. The calorific value of our coal is 10,816.85 B.t.u. per pound

$$\frac{2{,}719{,}575}{10{,}816.85} = 251.4\ lb.$$

of coal lost per hour, or

$$251.4 \times 24 = 6033.6\ lb.$$

per day = three tons, and three tons at $1.65 will be $4.95 per day, or $1806.75 per year.

This is our direct loss by radiation based on coal as delivered to the coal trestle. Our total loss, due to these uncovered lines, in steam condensed, which represents coal, labor, etc., necessary to generate and maintain steam at an average of 100 lb. pressure is as follows:

By the radiation of heat units from the exposed surface of the pipes, steam is condensed, due to the loss of its latent heat. As the latent heat of steam at 100 lb. gage is 879.8 B.t.u. per pound and we are radiating 750 B.t.u. per square foot of exposed surface per hour,

$$\frac{750}{879} = 0.856\ lb.$$

of steam per square foot of exposed surface per hour is condensed, and as this steam has done no work it is an absolute loss.

$$0.856\ lb. \times 3626.1\ sq.ft. = 3103.9\ lb.$$

of steam lost per hour. Our cost of steam is 11.63c. per 1000 lb.

$$3103.9\ lb. \times 0.1163 = 36.1\ cents$$

per hour, or $8.66 per day; $8.66 × 365 = $3160.90 per year lost due to condensation in these lines. This is equivalent to 90 boiler horsepower, or 11.7 per cent. of that developed.

Based on a sectional pipe covering of 70 per cent. efficiency, this loss can be reduced to about $950 per year, and possibly more, by installing a better grade of covering.

After giving up its latent heat, the condensation still has a heat value of 309 B.t.u. and is also free of most scale-forming substances. By installing suitable receivers and traps, a large amount of this water may be returned to the boilers at a fairly high temperature.

This system, with our pipes well insulated, should show a saving of 90 per cent. of the present loss, or about $2800 per year.

J. L. KEZER.

Bradford, Penn.

## Draining Steam Pipes

So many accidents to steam engines can be traced directly to water in the steam pipes that their frequency should result in the adoption of safeguards by all engineers and steam users, but each one apparently thinks that such an accident could not happen in his plant, simply because it never has.

Fig. 1 illustrates the pipe by which a double Corliss engine is supplied with steam. The main pipe from the boilers is brought down through the ceiling and fitted with a reducing tee, forming a branch to the right and left, as shown by the full lines. Each branch has a valve to shut off the supply if only one cylinder is used. Two 45-deg. ells are used in the right-hand connection, instead of one 90-deg. ell, to clear an I-beam which supports the ceiling at this point.

If this engine were to be shut down for several days and steam required in other departments of the shop, these two valves should be closed, but if this is done with the present arrangement, the pipe will fill with water and it would not be safe to open either valve, because water-hammer might split the pipe or crack the fittings.

If a reducing cross had been used at the point indicated by dotted lines, the small drip valve could be safely opened, because the outlet is too small to cause rapid circulation in a cold pipe.

In everyday service the small drip valves, shown above the throttle valves, are opened before the engine is started, and then closed. This disposes of water that has collected since the engine was shut down, but does not carry away any coming over from the boilers while the engine is running. The cross mentioned forms a good drip pocket and if the small pipe is connected to a reliable trap, it will keep the line practically clear. Relief valves on cylinders are valuable, but it is better to remove the water before it goes into the cylinders.

Fig. 2 illustrates a very poor form of pipe connection for a double engine. Nearly all water in the main pipe will go into the first cylinder; this is dangerous. If a good separator had been installed, as shown by the dotted lines,

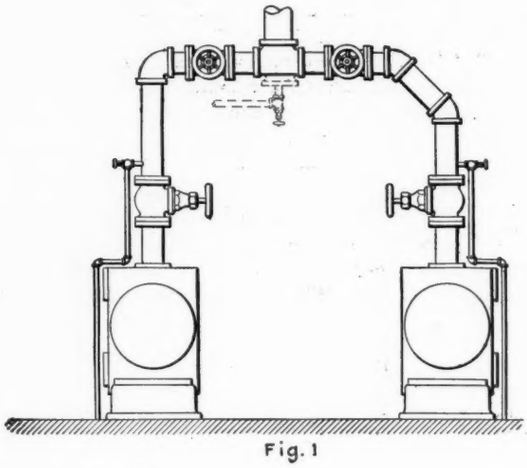


Fig. 1

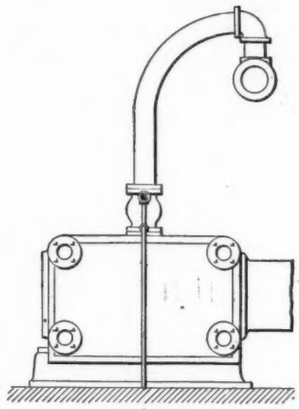


Fig. 3

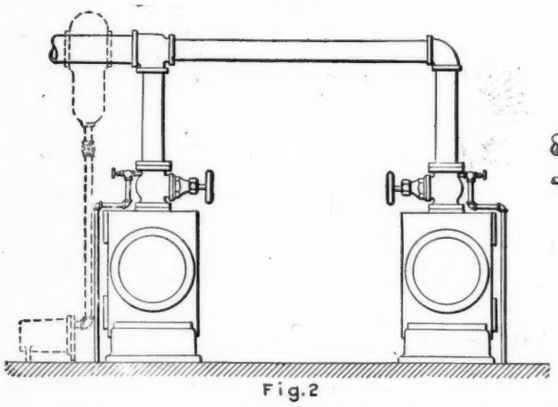
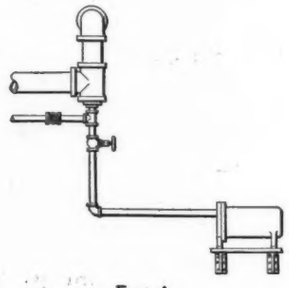


Fig. 2




STEAM PIPING SHOWING DRAIN LINES

and the drip pipe had a good trap, only dry steam could go to the engine.

Fig. 3 illustrates a good device used in a plant where the boilers prime badly, sending large quantities of water into the main steam pipe. As steam for this engine is taken from the top of this pipe, little will go to the engine unless the main pipe is nearly full.

Fig. 4 shows the end of this pipe and a tee connected to form an outlet at the top to supply steam for another engine. The bottom of the tee forms a good drip pocket and the pipe from it discharges into a trap. A tee in this pipe looks to the left, the outlet thus provided discharging into the boilers below the water line. This is used most of the time, and is preferred because the hot water is saved.

W. H. WAKEMAN.

New Haven, Conn.

## Water Level Fluctuates

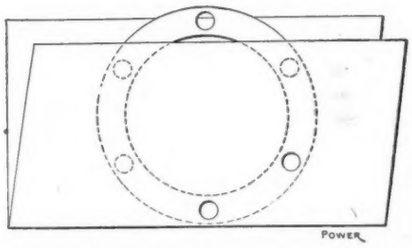
Our three-drum type Babcock & Wilcox boilers each have one water column and gage-glass connected to one of the end drums. The water will at times suddenly rise and at other times fall considerably in the glass. I believe it is due to local circulation within some of the tubes and one header. Will some interested reader experienced with this type of boiler fully explain the cause?

B. H. CHESTER.

New York City.

## Inserting and Removing Gaskets

When inserting a gasket between flanges that cannot be separated to any great distance, it is often troublesome to get the gasket into position. To overcome this, fold a piece of stiff paper as shown in the sketch. The paper and gasket can




GASKET READY FOR INSERTION IN FLANGE

easily be slipped in between the flanges, and after one or two bolts are put in place the paper can be taken out.

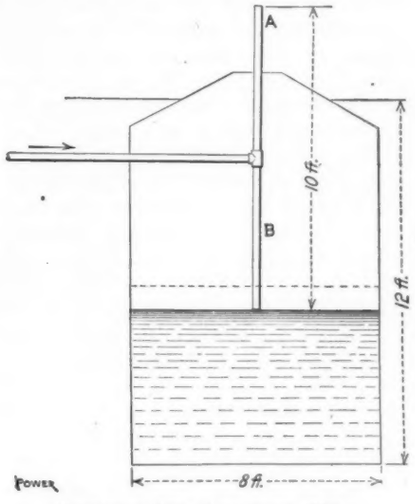
To remove an old gasket when the flanges can be separated but very little is usually difficult unless a length of pipe is taken out. A simple way is to drive a cold chisel in the lower side of the joint sufficiently to loosen the flanges, and then run an old saw through the joint, sawing out the gasket. After sawing partly through, drive the chisel in the top of the joint to keep the flanges from pinching the saw and saw out the remainder of the gasket.

EDWARD L. JOHNSON.

Brooklyn, N. Y.

## Why This Peculiar Exhaust?

The exhaust pipe from our engine is run into a well 12 ft. deep and 8 ft. in diameter; the pipe is connected as shown in the illustration. When the water in the well rises to the height indicated by the dotted lines, no steam is exhausted




EXHAUST PIPE LED INTO WELL

from *A*, which is open to the atmosphere, but when the water level is just below the end of the length *B*, both steam and water are exhausted from *A*. The top of the well is always open to the atmosphere. What causes this peculiar action?

A. O. FISHER.

Elkhart, Ind.

## Correcting a Centrifugal Pump Trouble

Recently I was consulted regarding a 4-in. motor-driven volute pump running with 4-ft. lift and 35-ft. discharge head that refused to raise water.

The pump and motor were on a subbase and to erect required only connecting the pipes and wiring the motor. A machinist did this and packed the shaft bearings. The pump would work well about 20 min. then gradually lose its water, although the supply was constant. The machinist and millwright tried for several weeks to fix it but unsuccessfully. During this time the superintendent wrote to the makers who stated that the pump was tested in the usual manner and found satisfactory before shipment.

First I examined the strainer and foot valve and found them clear, then I pulled out the packing and discovered the trouble. The water-seal glands were sent packed in a box with the other trimmings, and in packing, the machinist cut off a long piece of coil packing and wound it around the shaft and drove it in until the stuffing-box was full. As it got hot when running, he eased up on the gland nuts, letting air leak in and gradually destroy the vacuum. I found the water-seal spools hanging up in the machine shop. The machinist stated that he could find no place to use them. It took 40 min. to get the pump properly packed and working to full capacity with no further trouble.

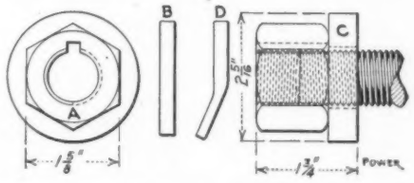
J. C. HAWKINS.

Hyattsville, Md.

## Stud Extractor

The illustration shows a stud extractor I made for pulling 1-in. studs from pistons. The studs had been in use over 10 years and were screwed in so tightly and closely that a socket wrench was the only tool possible to use.

The keyway in the nut *A* was cut just deep enough so that when the cutting key *B* was driven it would only cut the threads as far as the base of the nut. Screwing the nut on the stud a distance of five threads and driving the key give sufficient holding power to allow two men to back off the stud with a 36-in. pipe wrench. After the stud is withdrawn the




STUD EXTRACTOR

nut is placed in a vise so that the collar *C* rests on the jaws, and the key is then driven out with the driver *D*.

The extractor nut should be tapped deeply to allow for shrinkage, after which it should be case-hardened. The collar should also be case-hardened and the cutting key and driver made of tool steel. I made the collar large enough to fit the counterbore of the follower plate.

DAVID G. YOUNG.

Cliffside, N. J.

## What Corroded the Pipe?

A 1-in. wrought-iron gas pipe screwed in the top of a 4-in. cast-iron main was badly eaten away on one side only. Several holes were present, and around them along the side of the pipe was a large area that had materially wasted away; the interior was unharmed.

This pipe was laid only three years ago in a paved street. No other pipes run adjacent to it, and the street-railway lines and power house are a block away. Was electrolysis the cause?

J. E. B. PHELPS.

Sarnia, Ont.

# Questions Before the House

**Comment, criticism, suggestions and debate upon various articles, letters and editorials which have appeared in previous issues**

## The College Graduate and Practical Experience

The editorial "The Technical Graduate and the Power Plant," in the May 14 issue, and the foreword "To the College Grad," in the May 28 issue, are decidedly interesting to one who has recently gone through that part of the mill they refer to.

Some graduates feel it beneath their dignity to get down to manual labor as a starter after graduation, and when it comes to wiping up grease and getting under a machine to repair it, with the oil running down their neck, they would rather be excused; these men apparently have a yellow streak in their engineering makeup and like the "quitter" may "get by," but not as well as the man who is not afraid to get dirty.

A couple of years or more in a power plant as water tender, oiler, watch engineer, etc., going through the different minor positions, may be good experience, as noted in the articles referred to, but two years in a large industrial establishment brings one in contact with more and varied classes of men as well as positions than in a power house; after which a short while in a power house will be excellent final training, if the industrial establishment was one manufacturing power-plant apparatus.

A technical graduate can get much out of two years' practical training with a large industrial establishment, like the General Electric Co., for example. Let him start in the machine shop. Here he will learn how to run the various machine tools, and realize the different environment here from that in the college machine shop. Work must be got out because a promise has been made on this or that requisition. He will work, for example, with the day workers in the tool room or repair shop or he may spend some time with the piece workers who are pressed for time. In each part of the shop a different kind of human nature predominates; a study of this alone is well worth the experience. Finally, one may take charge of a small part of the work and here comes that valuable training in diplomacy of how to handle men.

Suppose he has had enough of the shop and now goes through the various tests of steam turbines, air compressors, gas engines, etc., if he be a mechanical man; motors, generators, transformers, meters, instruments, etc., if he be an electrical man. In each place he again applies his theoretical knowledge practically, and learns the short cuts the professional tester uses. Here a different class of men is encountered and points on human nature again are acquired that can be gained in no other way, besides that valuable experience of how to handle the apparatus he expects to operate, design, manufacture or sell, some day in the future.

Then comes the drafting office, and engineering office experience and perhaps some cost, or production department work, if he be inclined that way.

To cover all of it thoroughly would require more than two years, but at the end of that time, he should know definitely what branch he wants to follow. Then, if power-plant work be his goal, let him spend a short while in a power plant and he should soon master the details of his chosen work. If manufacturing, designing or selling were his choice, he could follow these up similarly in a practical way.

Some may say this is a long time to spend preparing for the engineering profession. Perhaps it is, but compare a physician—how long he studies, and how much time he spends at the hospital and then building up a reputation. Our profession has grown so in size that it cannot be mastered as easily as formerly.

JULIUS G. BERGER.

West Lynn, Mass.

## Why Clinker Forms

The peculiar difficulty cited by H. B. McDowell, in his inquiry in the May 7 issue, is not as easily explained or corrected as might at first appear.

The clinker formation is not due to the fuel, because two boilers, one with a special furnace and one with a standard furnace, are exempt, and the second boiler with the special furnace only evidences trouble in a particular part of its grate.

The difficulty might be due to the tubes comprising the water bars, which at the particular part of the furnace where clinkers form may be found to be dirty inside, and thus permit the fire to be hotter at that point than it would be if the heat was absorbed by a perfect circulation of water.

Another solution may be found in the draft. Ordinarily, the boiler most distant from the stack would have the poorest draft, and the boiler referred to is farthest from the stack. It is possible, however, that the individual dampers, if such exist, may be so adjusted that this particular furnace has the most intense draft at the particular point where the clinkers exist, and it may be found to produce most intense heat at that point and thus cause the formation of clinker.

There is a positive reason for this particular formation, but without complete data on the entire plant, or draft in this particular furnace in comparison with the others, and the degree of cleanliness maintained, it is hard to suggest any conclusive reason for the existence of the trouble.

I trust we shall hear further from Mr. McDowell on this matter, and particularly so when he finds the reason for his difficulty. I would experiment with the conditions of draft of the three boilers in a comparative way, and also take measures to alter the thickness of the fuel bed on this particular boiler, and carefully note any effect that might be produced. If such investigations do not develop a solution, the cleanliness of the water bars should be next given attention.

CHARLES H. PARSON.

New York City.

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My experience leads to the belief that Mr. McDowell's clinker trouble is due to the following causes:

The temperature of the fire is greater on the side which formed the clinker; this is caused by more hot air being furnished and more combustible gases being distilled and burned. This condition could exist due to some peculiarity of furnace, gas passages and breeching which produce eddy currents.

CECIL R. COILE.

Fort Morgan, Ala.

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Mr. McDowell's trouble is undoubtedly due to poor draft. With the Hawley down-draft system particular attention should be given the draft as it must be strong to produce good results. The chimney draft, if poor, will produce smoke and clinker, and if Mr. McDowell is troubled with smoke he may reasonably attribute the clinker to this cause.

As the upper furnace containing the water-bars is used only as a chamber for distilling the gas from the coal, it is important that distillation should be

complete, leaving only coke to be burned on the lower grate. If it is not quite complete and the fuel is high in sulphur, clinkers will result, especially if the draft is poor.

I would suggest that Mr. McDowell look for clogged air spaces in that part of the lower bars affected. He might also see if the middle door closes tightly, and if the damper on No. 3 boiler is working well. Admitting additional air through the lower ashpit might stop the trouble if the breeching and grate bars are unobstructed.

B. H. CHESTER.

New York City.

## Unnecessary Risks

The reply to "Unnecessary Risks," by Charles J. Mason in the June 4 issue, is rather inaccurate. I analyzed it and then asked an old Scotch engineer how he plugged tubes before patent expanding tube stoppers were made.

Mr. Mason says the fire in a Scotch boiler was smothered with green coal. We will allow that no carbon dioxide or other obnoxious gas was generated, and that the furnace temperature was anything you like to call it.

The diameter of Scotch boiler furnaces in those days, say 25 years ago, was rarely over 3 ft., but assume it was 4 ft.—an unheard-of size for that time and uncommon now. The tops of the fire bars were about the center of the furnace; this would allow 2 ft. from the tops of the bars to the top of the furnace. With soft coal the center fire bed would be from 6 to 10 in. thick, but call it only 8 in. thick. On top of this green coal was spread, say as thin as 2 in., and on top of the green coal planks were placed. Allowing for a 2-in. plank, we have

$$2\ ft. - (8\ in. + 2\ in. + 2\ in.) = 12\ in.$$

between the bars and furnace top at the exact center of the furnace. I would like to know how men went in a space 12 in. high "on their hands and knees."

A man of average height with the femur or thigh bone at right angles to the body measures about 2 ft. from the knee to the back. The way the job really was done (and sometimes is done to this day when the tube is so badly salted that a patent stopper will not go through) is this:

The fire was drawn; planks were laid on the bars after they had cooled a little. With the necessary plug, washer and nut, the engineer crawled in the furnace and lay on his back. The engineers or firemen on the outside pushed on his feet and slid him to the "back end" or combustion chamber. If the tube was low down he could possibly reach it from his position on his back on the planks. If he could not reach it, short pieces of plank were passed to him and these he laid on the floor of the combustion chamber to stand on. If two furnaces ran into a common combustion chamber, both fires had sometimes to be drawn but there was no danger about the job beyond the chance of a few drops of scalding water, and generally a liberal supply of old sacks would prevent any trouble from this source.

A really dangerous job, permitted or even ordered by some marine chiefs, was expanding tubes while the boiler was under pressure. My informant said he had been ordered to do this many times.

The Scotch boiler in this ship had four furnaces, two at each end, with a combustion chamber for each. The fire was drawn in the furnace below the leaky tubes and planks were laid on the grate and the combustion-chamber floor. The pressure in the boiler was 50 lb., just 10 lb. below the blowing-off pressure. With a Dudgeon tube-expander the engineer went into the back end to expand the tubes. He would take 10-min. spells; that is, he would spend 10 minutes in the back end and 10 minutes under the ventilator in the stokehold. If the tube were cut by the expander, the engineer would have been boiled alive.

L. A. SUVERKROP.

New York City.

## Central and Isolated Plants

Previous discussion on this subject leads me to believe that the owners are more to blame than the engineers for the displacement of isolated plants with central-station service. We are advised to keep records of operation in plants under our charge. Records are beneficial if properly kept and interpreted, but they will not rebore a cylinder that is out of true and wasting steam, nor buy latch blocks for the old Corliss engine that has been in service since Adam was a boy.

Owners will often go to great expense in other departments to obtain the highest efficiency. Why not include the engine room; is it not one of the most important departments and worthy of the same recognition?

It is positively unjust that some engineers have to almost beg for the necessary supplies to keep the plant in successful operation. While talking with a salesman for a well known line of packing and supplies, I asked him if he had called on Mr. Smith, and he replied: "I went to the office and stated that I would like to show their engineer my line of goods and I received this answer: 'No; we buy all the supplies, and if the engineer we have cannot get along with them, we will get one that can.'"

I wonder if that same superintendent would buy stock suitable for making a $2.50 pair of shoes and then expect his men to turn out a $3.50 pair.

When the plant owners coöperate with their engineers as they do with the heads of other departments they will realize that they can furnish power cheaper than the central station can sell it.

J. M. HEALY.

Uxbridge, Mass.

## Frictional Losses

In a recent issue of POWER friction load was discussed and in the case cited was found to be 24 per cent. of the total full load. Following this the article reads: "This figure was ascertained by stopping all machines and running only the shafting and belts on idle pulleys." I would like to ask was the friction load measured (1) on a cold or hot day, (2) on a damp or dry day, (3) at starting or stopping time, (4) on the first or last day of the week?

When a comparison of friction loads in different plants is made, it is essential that it be measured in each plant when the conditions are as nearly identical as possible. Otherwise no fair comparison can be made.

Those who have studied the question know that the friction load is apt to be higher in cold dry weather (in plants using leather belts); at starting time (because the lubricant in the bearings is set and stiff) and on the first of the week for the same reason.

A discussion of this subject would be extremely interesting. Why is the friction load in some plants as low as 18 per cent. while in others as high as 62 per cent.? Is not less attention generally given this subject than it warrants? How many engineers regularly take cards from their engine to ascertain the full load as well as the friction load, and how much variation in friction load in the same plant is caused by the influences above mentioned?

CHARLES F. CHASE.

New York City.

## Clamps and Lacing versus Cement for Belts

In the Apr. 16 issue, J. N. Fries states in his article on belt lacing that a wire-laced belt is the best. From a standpoint of safety, all belt fasteners or lacing are dangerous to the operator of a machine or to workmen in close proximity to the belt.

To be absolutely on the safe side, all leather belts should be made endless by a cemented joint. Belt cement can be obtained that will cement a belt with a loss of time of from 10 to 20 minutes, so that this delay does not amount to much. A handy man can be easily taught to do this work, and it will prove of benefit to the men, the machines and the shop in general. The belt will run smoothly, the flapping noise due to the weight of a fastener will cease, and, best of all, the workman cannot get his clothing caught

and be whirled about in the shafting.

All belting that is liable to come in contact with the workmen should be guarded up to 6 ft. from the floor, no matter how the belt is fastened together.

A. RAUCH.

Pittsburg, Penn.

## Failure of Boiler Tubes

In a recent issue, W. J. Maxwell asks why boiler tubes fail. This is due in many instances, especially with water tubes, to an improper distribution of heat caused by baffle wall interference.

Flame plates and high bridge-walls produce right-angle turns of the hot gas currents, causing changes of temperature in different places. Especially if liquid fuel is burned. Air passing through the grates will be more evenly distributed to all exposed tube surface if all baffle walls, etc., are discarded.

The current then passing through in curves and bends will naturally be more effective. The bagging of tubes and leaky tube ends is caused by the chemical changes of the water inside of them and the end leaks are more or less due to excess air. My 12 years' experience with boilers, using both coal and liquid fuel, and the many tests I have seen made on tubes, boilers and furnaces in a leading university, confirm the above.

J. H. SMITH.

Austin, Tex.

## Lacing Belts

The recent discussions on belt lacing interested me. A long and varied experience with belts has taught me that cementing, wire-lacing and rawhide lacing are the only correct ways to join belts. The first should be used for belts from 8 in. to 6 ft. wide and from 2 to 3 ply thick. These belts do not require tightening so frequently and cemented are very safe when driving full load. Wire-lacing should be used on belts from 1 to 8 in. wide, heavy or light double thickness. If properly laced with composition wire and the strands are hammered flush with the surface, the joint is hard to surpass. All cone-pulley belts, on lathes, for example, are better if laced with rawhide as they may be easily and safely handled.

Overhead or line-shaft belts, heavy or light double thickness, give better results when laced with wire. I have thrown wire-laced belts on pulleys many times when running full speed, and never received a scratch because the belts were properly laced and a piece of leather was used to protect my hand. The leather used, cut from an old single belt and thoroughly pliable, was circular in form and 5 in. in diameter. This hand protector must be grasped by the thumb and forefinger and under no circumstances fastened to the hand as a defective belt might catch it, causing injury. I have put the tightest of belts on pulleys in this manner.

Single belts from 1 to 8 in. should be rawhide laced. Strong, thin lacing is best. Wire works better in double than in single belts for the reason that in hammering the wire level with the belt face the leather is weakened because twice the diameter of the wire is sunk into the single ply of the leather, weakening the section, and the joint will part under sudden strain. For the best rawhide lacing of single belts the holes must be of the right size and punched in the proper places.

Of the many ways of lacing belts with rawhide I found but two which were satisfactory in saving time and giving results, the straight strand and the hinge joints. Rawhide lacing is excellent for single or double belts that have lost toughness through age, moisture or oil.

JAMES MCCLURE.

Fletcher, N. C.

## Driving a Small Pipe Well

The pipe-well drill shown by George J. Little in the Apr. 2 issue is of serviceable construction except that a wooden block should be used on the driving plug to prevent it from being battered out of shape.

My experience with a similar machine teaches me that if great care is not taken, the threads on the pipe will be stripped due to the heavy blows from the driver.

JOHN THORN.

London Junction, Ont.

## What Caused the Sediment?

Mr. King's trouble, mentioned in the Apr. 30 issue, is evidently due to bicarbonates in solution in the feed water. The deep red color of the deposit proves that there is a large proportion of iron. That the scale is hard to detach indicates the presence of lime and probably alumina. An analysis of the scale would be the best way to determine its composition.

These bases exist in the feed water as perfectly clear solutions of their bicarbonates. As soon as the water becomes heated in the boiler, carbon dioxide is evolved, breaking up the bicarbonates and leaving the lime, iron oxide, etc., in the form of the fine sediment referred to.

It would be best to purify the water before using. This can be done easily by adding a calculated amount of soda and moderately heating. In a small plant, the installation would probably cost more than the damage done by the scale.

A good boiler compound, or simply soda ash, should be added to the feed water. This will precipitate the impurities in a more granular condition, and frequent blowing off will remove the greater part of them. I have known of boilers being blown off every six instead of twenty-four hours when using a feed water with much lime in it.

C. T. DAWKINS.

Ashland, Wis.

## Water Broke the Piston

Mr. Haight's trouble, mentioned in the May 7 issue, in my opinion is caused by water being carried over from the boilers. The fact that the piston rod was bent in one engine and the crank and crosshead were damaged in the other is proof that the piston struck something solid, such as water under compression. The piston, being weaker than the head, let go instead of knocking out the latter.

Any number of traps on a steam main will not relieve an engine cylinder of a sudden dose of water caused by the fireman pumping the boiler full. I have seen piping systems equipped with both traps and drainage systems and, in case of sudden flooding, the traps or the system were useless.

As for water getting into the piston, I cannot see how it can possibly expand and create a pressure because it could get out the same way it got in.

W. F. O'REGAN.

Salem, Mass.

## Gasket Broke Filter Flanges

W. G. Freer's account of a broken condenser head in the Apr. 9 issue, reminds me of a similar experience. Two 36x72-in. water filters were being installed, and each filter was in two sections of 36 in. each, the sections being flanged and each contained thirty-two $\frac{5}{8}$-in. bolts. Rubber tubular gaskets were used having $\frac{3}{8}$ in. outside and $\frac{1}{8}$ in. inside diameters, and the ends were joined by inserting a short piece of $\frac{1}{8}$-in. soft fuse metal into each.

The erectors laid the gaskets just inside the bolt circle and then tightened the joints, but in making the last round a helper pulled too hard on the wrench and cracked the flange at the hub for a distance of four bolt-holes. The flanges had a 4-in. face and it was 2 in. from the bolt circle to the inside edge of the flange.

The trouble was attributed to a defective flange. A new section was put in and after about two hours' service a sheet of water issued from the new joint. Investigation showed a break identical with that of the recently broken flange.

I condemned the type of gasket, and contended it was responsible for both breaks, the erector arguing to the contrary and claiming the flanges were defective. Finally a sheet-rubber gasket was used, and after six months' service the joint is still tight. To my mind, the gasket acted as a fulcrum, causing undue stress on that portion of the flange which was being tightened.

L. M. JOHNSON.

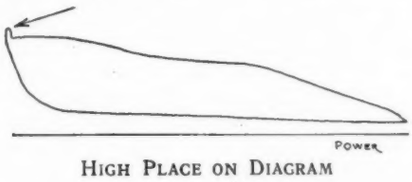
Glenfield, Penn.

# Inquiries of General Interest

**All Questions Must be Accompanied by Name and Address—Not for Publication**

## *High Place on Diagram*

The diagram submitted is from a compound Corliss engine which has two eccentrics, and runs non-condensing with considerable back pressure, as the exhaust is supplied to turbines. What is the cause of the high place on the diagram indicated by the arrow? The




HIGH PLACE ON DIAGRAM

trouble is not with the indicator, for it does not show on diagrams taken from other engines with the same instrument.

W. J. L.

It is impossible to say from the information given. Take a diagram from the receiver and study the difference between the receiver pressure and the steam line of the diagram at this point. This study can be facilitated by taking the motion for the paper drum of the indicator from the eccentric or valve motion instead of from the crosshead, which will spread out this portion of the diagram and make it easier to analyze.

## *Lining up an Engine*

Without disconnecting any parts of an engine, how can it be ascertained whether the crankshaft is at right angles to the center line of the cylinder?

W. H.

Stretch a fine braided line over the engine parallel to the crankshaft and stretch another such line, just touching the first one, parallel with the center line of the cylinder. The longer the lines the better, provided they are set taut and firm. With a light pine rod or tram, locate equal distances on the line parallel with the crankshaft, each side of its intersection with the line which is parallel with the cylinder center line. Then if the shaft and center line of cylinder are at right angles to each other, any point on the line parallel to the cylinder center line will be equidistant from the points first laid off on the line parallel to the shaft.

Instead of taking an equal distance on each side of one of the lines, the angle between them can be tested by laying off a point on each at distances from the point of intersection in proportion of 3 to 4 and testing the length of the hypothenuse, which should be 5 to the same scale if the two lines are at right angles with each other. It is better, however, where space will permit, to check the angles as by the first method, and even better to test the equality of all four angles made by the cords at their point of crossing. In setting the lines parallel with the shaft or center line of cylinder, in each case select two points of reference that are as far apart as possible. The line intended to be parallel with the shaft may usually be set by plumbing direct over the shaft center points, or by horizontal measurements to plumbings taken with proper allowance for any differences in diameters at the points of measurement.

The line parallel to the center line of cylinder may be located in a similar manner with reference to any bored or turned-off part of the cylinder which is concentric with the center line of the cylinder.

## *Gearing a Motor*

Is it well to use a pair of ordinary cast-iron spur gears for a drive from a 75-hp. motor making 715 r.p.m. to a shaft which is to make 85 r.p.m.?

J. Q. A.

It would be better to use an adjustable intermediate gear than to depend upon adjusting the position of the motor to preserve proper distance between centers. On account of the high speed of the motor, cast iron would not be as suitable for the spur gear which meshes with the gear on the motor, as cast steel, or bronze, or a wheel with wooden teeth, all of which withstand vibrations better than cast iron. It would be better still to employ spiral gearing or some form of smooth running gear wheels.

## *Pressure in Discharge Line*

When a pump is not running, what pressure should be indicated by a gage when connected with the pump's discharge line to a tank, at a point which is 125 ft. below the tank, with 10 ft. depth of water in the tank? What causes the gage to indicate more pressure when the pump is discharging to the tank and upon what does the increase depend?

A. T.

When the pump is at rest and there is no leakage or discharge from the line, the total head at the gage would be 125 + 10 = 135 ft. The pressure per foot of head being 0.433 lb. per square inch, the gage should indicate

$$135 \times 0.433 = 58.455$$

or practically 58½ lb. per square inch. When the pump is discharging to the tank the pressure indicated by the gage will be increased by the amount of pressure lost by friction beyond the place where the gage is attached. The amount of increase depends upon the size and length of the line, the fittings in the line and the velocity at which the water is pumped through the line.

## *Friction of Elevator Plunger*

When the plunger of a plunger-type elevator is all the way down in the cylinder, does the hydraulic pressure against the cylindrical surface of the plunger create frictional resistance to starting the plunger in motion or tend to retard the plunger while it is in motion?

H. T.

No; fluid friction is independent of the pressure of the liquid.

## *Effect of Boiler Patch*

How much reduction should be made in the pressure carried on a 60-in. diameter by 16-ft. boiler on account of the shell having a patch 15 in. wide by 18 in., measured girthwise of the boiler?

H. F.

If the patch has no corners less than 6 in. radius, is made of soft iron well shaped to fit up against the boiler shell and has a single row of rivets equal to the girth-seam riveting of the boiler, then the presence of a repair patch should not require any reduction in pressure to be carried on the boiler.

## *Tube Expanders*

Is it good practice to use a taper plug for expanding the ends of boiler tubes? Is a roller expander better, and, if so, why?

H. M.

It is not good practice to expand boiler tubes by swedging their ends with a taper plug as it crystallizes the tube ends and produces irregular bearing of the tube around the tube-sheet hole. A roller expander is better as it stretches the tube gradually and presses the inequalities of the tube up to uniform bearing all around the tube-sheet hole.

# Study Questions

**This Week's Questions**
**Last Week's Answers**

31. An electrician making up a bank of resistance with a certain number of incandescent lamps (less than 100), found that if he arranged them in three rows he would have one left over, in four rows two left over, in five rows three left over and in six rows four left over. How many lamps had he and in how many rows could he arrange them with none left over?

32. A water tower 200 ft. high is encircled exactly five times by a spiral stairway from the ground to the top, the length of which measured along the wall of the tower is 282 ft. 10 in. What is the diameter of the tower?

33. How many degrees above absolute zero is each of the following temperatures: 60, 100 and 247 deg. F., and 0 and 100 deg. C.?

34. What was the original temperature of a pound of cast iron (specific heat = 0.13) if its immersion in 2 gal. of water at 62 deg. F. raises the temperature of the water to 71 deg.?

35. How much does a brick chimney weigh, 32 ft. high, with walls 8 in. thick throughout, if it measures 40 in. square on the outside at the top and 40 in. square on the inside at the bottom, assuming the brickwork to weigh 120 lb. per cubic foot?

*Answers to the above will appear in the next issue. Answers to last week's questions follow:*

26. On one side the crank and connecting-rod are in a straight line so that 7½ ft. is the sum of their lengths. On the other side a right triangle is formed by the connecting-rod as the hypothenuse, the crank as the altitude and the crosshead to axle distance as the base.

Let

$x$ = Length of the crank;

$7\frac{1}{2} - x$ = Length of the connecting-rod.

Since the hypothenuse of a right triangle equals the sum of the squares of the other two sides,

$$(7\tfrac{1}{2} - x)^2 = x^2 + (6.125)^2$$

$$56.25 - 15x + x^2 = x^2 + 37.5156$$

$$15x = 18.7344$$

$$x = 1.24896$$

or closely 1¼ ft. or 15 in.

$$7\tfrac{1}{2} - x = 6.25104$$

or closely 6¼ ft. or 75 in.

27. Since a cube is the form of a closed rectangular tank having the least surface area for a given volume, each half holds its maximum and it naturally follows that a half a cube is the form of an open tank to hold the most. Certainly the base should be square and it can be shown that the height should be one-half of one edge of the base.

Let $x$ = one edge of the base and $\frac{x}{2}$ = height. Then the volume is

$$x \times x \times \frac{x}{2} = \frac{x^3}{2} = 8 \text{ cu.ft.}$$

and

$$x^3 = 16;$$

$$x = 2.5198 \text{ ft.};$$

$$\frac{x}{2} = 1.2599 \text{ ft.}$$

The tank should therefore be 2 ft. 6¼ in. by 2 ft. 6¼ in. on the bottom and 1 ft. 3⅛ in. high and will have a total surface area of

$$2.5198 \times 2.5198 + 4\,(2.5198 \times 1.2599) = 19.048 \text{ sq.ft.}$$

To prove that this tank requires the least material for its volume, try other values for the height each side of the one determined and figure the corresponding base dimensions and it will be found that the total surface areas will exceed that given above.

28. As explained in answer No. 24,

1 deg. F. = $^5/_9$ deg. C.

1 deg. C. = $^9/_5$ deg. F.

Account must be taken of the different zero positions—on the Centigrade scale at freezing point and on the Fahrenheit scale 32 deg. below freezing. Therefore, after converting a Centigrade reading to Fahrenheit, if above zero 32 deg. must be added, and if below zero, 32 deg. subtracted, and a Fahrenheit reading before being converted to Centigrade, if above zero, must have 32 deg. subtracted and if below zero 32 deg. added.

| Deg. F. | | Deg. C. | Deg. C. | | Deg. F. |
|---|---|---|---|---|---|
| 5 | = | −15 | 1 | = | 33.8 |
| 14 | = | −10 | −30 | = | −22 |
| 41 | = | 5 | −25 | = | −13 |
| 68 | = | 20 | 90 | = | 194 |
| 158 | = | 70 | 120 | = | 248 |
| 266 | = | 130 | | | |

29. The section of the bar is 2 × ½ = 1 sq.in., the length 36 in., making the volume 36 cu.in. A cubic foot (1728 in.) weighs 480 lb.; then 36 cu.in. weighs

$$\frac{480}{1728} \times 36 = 10 \text{ lb.}$$

30. One gallon of water weighs 8.3356 lb.

$$Hp. = \frac{\text{work in. ft.-lb.}}{\text{time in min.} \times 33{,}000} =$$

$$\frac{108{,}000 \times 8.3356 \times 250}{60 \times 33{,}000} = 113.6672$$

Errata: In the answer to question 14, June 4, the weight of the ladder was inadvertently taken as 62 lb. when the original question gave it as 60 lb., and the length of the ladder as 25 ft. when it should have been 30 ft. These inaccuracies affected equations (a) and (c) which should have been

$$60 \times 6.14085 = 368.451 \qquad \text{(a)}$$

and

$$30 \times \sin. 65 \text{ deg. } 50 \text{ min.} = 30 \times 0.91236 = 27.3708$$

and the moment

$$X \times 27.3708 \qquad \text{(c)}$$

making the correct answer

$$(X \times 27.3708) - 368.451 - 1535.2125 = 0$$

$$X = \frac{1903.6635}{27.3708} = 69.55 \text{ lb.}$$

Errata: In the answer to question 19 in the issue of June 11 an error was made in reducing the equation for $v^2$. It should have been

$$v^2 = \frac{1737.794}{0.9627} = 1805.1251$$

$$v = 42.48 \text{ ft. per second.}$$

## New York State Convention of the N. A. S. E.

The seventeenth annual convention of the New York State Association of the National Association was held at Yonkers, June 14, 15 and 16, with headquarters at the Getty House.

More than one hundred firms occupied booths in the main hall of the armory, which was tastefully decorated and arranged for the largest mechanical exhibit in the history of the state association. The meetings of the delegates were held in an adjoining hall, making it convenient for them to visit the display. About fifty delegates and alternates were present besides delegates from associations in all parts of New York State and New Jersey. The exhibit proved of great interest, and was largely attended during the three days.

The convention was formally opened at ten o'clock on Friday morning. Charles Graham, chairman of the local committee, called the body to order and introduced Mayor James T. Lennon, who made a warm speech of welcome. National President Edward H. Kearney responded, and spoke upon the general topics of the N. A. S. E. Nathan A. Warren, president of the Chamber of Commerce, talked interestingly of Yonkers, and James R. Coe, national state deputy, responded. Campbell Scott, superintendent of the Otis Elevator Co., then extended an invitation to visit the company's plant, which was acknowledged by State Vice-president George O. Kaley. Following the appointment of several committees, the meeting adjourned until Saturday morning.

At the remaining sessions the business of the convention was rapidly and harmoniously dispatched. Financially the organization is in a healthy condition. A resolution was passed to have one delegate to every twenty-five members instead of fifty as heretofore, the object being to get a bigger representation. A small assessment was placed upon each member of the association connected with the state association for the advancement of the educational work. Edward Lee was

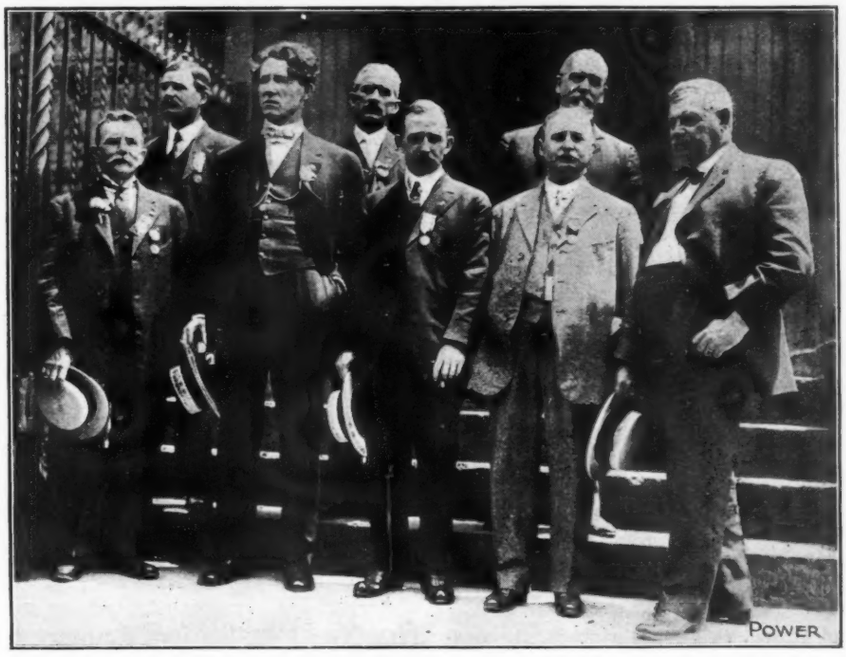
elected a committee of one to officiate with the labor and industrial committee at Albany to further the interest in the license movement, and a sum not to exceed five hundred dollars was appropriated for this purpose.

On Friday at noon the delegates and guests inspected the Otis Elevator Co.'s works. Lunch was served and the visitors were pleasantly entertained. That afternoon many of the guests were invited to the home of Tim Healy, president of the Firemen's Association, where they were heartily received and were served a good dinner. In the evening an enjoyable vaudeville entertainment was given in the exhibition had by the New York "Bunch."

Sunday afternoon there was a sail on the Hudson River with refreshments, music and dancing.

The election of state officers resulted as follows: George O. Kaley, president; Charles Fradenberg, vice-president; Edward Pruyn, secretary; William Downes, treasurer; George Harris, conductor; James Fitzgerald, doorkeeper; Joseph Gregory, chaplain; E. T. Gilroy, state deputy; Past President Charles Schabecker, special state deputy.

It was unanimously voted to hold the next convention at Yonkers in June, 1913.




NATIONAL PRESIDENT AND STATE OFFICERS OF THE N. Y. STATE N. A. S. E.

THE EXHIBITORS

Albany Lubricating Co., Alberger Pump & Condenser Co., Alsen Cement, American Engine Co., American Huhn Metallic Packing Co., American Steam Gauge & Valve Manufacturing Co., American Tool & Machine Co., V. D. Anderson Co., Armstrong Cork Co., Ashton Laird & Co., Boig & Hill, Buhne Metallic Packing Co., Chapman Valve Manufacturing Co., Clement Restein Co., Cling Surface Co., Cochrane Heaters, C. T. Coe Co., Coralline Drug & Chemical Co., Crandall Packing Co., M. T. Davidson Co., Dearborn Drug & Chemical Works, Dodge Manufacturing Co., Duryea Manufacturing Co., Eddy Valve Co., Engineers Mill & Supply Co., Erie City Iron Works, Estate of Edward R. Laden, Fuel Engineering Co., Garlock Packing Co., Green Fuel Economizer Co., Greene, Tweed & Co., Hawkeye Compound Co., Heine Safety Water Tube Boiler Co., Hewes & Phillips Iron Works, Homestead Valve Manufacturing Co., Home Rubber Co., International Acheson Graphite Co., Iron Works Co., Jefferson Union Co., Jenkins Bros., Keystone Lubricator Co., Knickerbocker Smokeless Coal, Lagonda Manufacturing Co., Leslie Co., Samuel Lewis, Lunkenheimer Co., McLeod & Henry Co., W. B. McVicker Co., Manning, Maxwell & Moore, H. W. Johns-Manville Co., J. O. Meara, Inc., *National Engineer*, National Flue Cleaner Co., New York Belting & Packing Co., Ohio Injector Co., Otis Elevator Co., J. E. Pawson Co., Peerless Rubber Co., Philadelphia Grease Manufacturing Co., Pitts & Kitts Manufacturing & Supply Co., William Powell Co., POWER, Power Specialty Co., Platt Iron Works, *Practical Engineer*, John R. Robinson, A. Roebling's Sons Co., Roto Co., Joseph C. Ryan, Schaeffer & Budenberg Manufacturing Co., Sherwood Manufacturing Co., Shipley Construction & Supply Co., Skinner & Connolly, Smooth-On Manufacturing Co., *Southern Engineer*, C. E. Squires, Murphy Stoker, J. L. Trumby Co., Under-Feed Stoker Co. of America, Vulcan Soot Cleaner, Washburn & Granger, F. W. Webb Manufacturing Co., Westchester Lighting Co.

## Kentucky N. A. S. E. Convention

The local committee at Owensboro, where the tenth annual convention of the Kentucky State association of the National Association of Stationary Engineers was held, did full justice to the reputation for hospitality which the Kentuckians justly enjoy. Although the business part of the convention occupied only two days, June 14 and 15, many delegates and guests were on the grounds so that the supplymen's exhibit was opened a day earlier. The exhibit and the business meetings were held in the Owensboro armory, which was ideal for both purposes.

The convention was opened by J. H. Oelze, state president, at 10 a.m., Friday, June 14. After the prayer offered by the Rev. Lewis Powell, Mayor Lambert welcomed the members and guests to Owensboro. In responding, Fred Raven, the national secretary, told of the work of the association and its growth. George H. Cox then spoke on "Our City," enlarging upon the physical, financial and social advantages of Owensboro. After the various committees were appointed by President Oelze, the exhibit hall was formally opened by Charles Cullen, vice-president of the Central State Exhibitors Association.

The afternoon session was taken up entirely with organization business, such as reports of the various officers and committees. The license-law committee was continued with the same personnel and instructed to use every legitimate means to increase public interest toward securing the enactment of a competent law.

For the evening the delegates and visitors were the guests of Kentucky Association No. 9 on its annual moonlight excursion on the Ohio River.

At the Saturday morning session reports were received from the various standing committees and numerous addresses were made. W. H. Corwin, Kentucky Association No. 2, Ashland, spoke on "The Benefits To Be Derived from a License Law in Kentucky." Frederick L. Ray, Kentucky Association No. 1, Louisville, delivered two papers, one entitled, "Self-Reliance, the Power Behind Many Successful Lives," in which he cited many examples of success achieved in the face of almost heart-breaking handicaps, simply through self-reliance, and one on "Our Educational Work," outlining a system of suitably graded questions which the author proposed should be published each month in the official organ of the association, *The National Engineer*. The questions were to be divided into three grades, elementary, intermediate and advanced, so that men of all stations could participate and the winners in each grade were to be awarded cash prizes.

E. H. Breidenbach, Kentucky Association No. 9, Owensboro, who is manager of the municipal lighting plant and waterworks, gave an illustrated lecture on "Water Purification" in which he described the methods employed at the plant of which he has charge and which he illustrated with numerous photographs of the plant itself.

Charles D. Scott, Kentucky Association No. 8, Henderson, gave a brief address on "Engineering in a Small City," in which he told of the handicap of operating engineers in small communities where opportunities for advancement are scarce.

Hopkinsville was selected as the meeting place for the next convention and National Secretary Raven installed the following officers, elected for the coming year: J. L. Shrode, Hopkinsville, president; C. Carroll, Louisville, vice-president; J. R. Morris, Hopkinsville, secretary; E. Kochenrath, Louisville, reëlected treasurer; J. H. Stamper, Lexington, conductor; J. N. Draper, Henderson, doorkeeper; T. E. Hopkins, Louisville, state deputy.

The meeting then adjourned and the delegates and guests assembled in a large open lot adjacent to the armory where the annual barbecue and fish-fry was held at 1 p.m.

In the afternoon an automobile ride was taken to various parts of the city and in the evening an entertainment was given by the Central States Exhibitors Association.

The following members of the Central States Exhibitors Association had representatives in attendance and suitable exhibits of their products: American Steam Gauge & Valve Manufacturing Co., V. D. Anderson Co., Crandall Packing Co., Dearborn Drug & Chemical Co., Garlock Packing Co., Greene, Tweed & Co., Hawk-Eye Compound Co., Hills, McCanna Co., Home Rubber Co., Jenkins Bros., H. W. Johns-Manville Co., Keystone Lubricating Co., Lunkenheimer Co., Osborne Valve & Joint Co., William Powell Co., POWER, Schaeffer & Budenberg Manufacturing Co., C. E. Squires Co., United States Graphite Co. The following associate members were also represented and had exhibits: Diamond Power Specialty Co., W. H. Niell Co., Lagonda Manufacturing Co., Guenther-Wright Machine Co., James Clark, Jr., Electric Co.

## International Electrical Congress

The officers for the International Electrical Congress, to be held in San Francisco at the Panama-Pacific Exhibition in 1915, have been announced. The committee of organization: Charles P. Steinmetz, president; Arthur E. Kennelly, vice-president on program; C. O. Mailloux, vice-president on international relations; W. D. Weaver, vice-president on organization; Henry A. Lardner, vice-president on Pacific Coast relations; Edward B. Rosa, secretary, and Preston S. Millar, treasurer and business manager. These officers constitute the executive committee and were appointed by President Dunn, of the American Institute of Electrical Engineers.

In addition, President Dunn has appointed other institute members, who are also members of other national bodies, to coöperate with the executive committee in the work of the congress. Among the associations so represented are the American Electric Association, American Electrochemical Society, Association of Edison Illuminating Companies, Association of Railway Electrical Engineers, Canadian Electrical Association, Empire State Gas & Electric Association, Franklin Institute, Illuminating Engineering Society, National Bureau of Standards, National Electric Light Association and Society for the Promotion of Engineering Education. The committee of organization includes members appointed from the Pacific Coast and 56 members-at-large.

## Coaling the "Moltke"

Before starting home to Kiel, the German squadron was coaled at its anchorage in the Hudson River. It was a small job to fill the bunkers of the "Stettin" and the "Bremen," but it took 200 of the German tars all day to put the 3600 tons into the "Moltke" necessary to make the homeward voyage.

On each side of the ship two big derricks extended over the coal barges, with six pulleys each with cable connections. The sacks were lowered from these pulleys to the barges, filled and then hooked and hoisted by electric winches on board, each having an individual motor. As each sack swung free of the sides of the vessel, which are covered with canvas and padded to insure them against scratches, two sailors seized it and gave it a yank which sent its contents down a chute to the bunkers.

## Fire at Newark Plant

Four substations of the Public Service Electric Co., at Newark, N. J., on June 13 were shut down by a fire which burned out the cables in the company's power house. Several municipalities supplied with light and power from these substations were cut off for several hours.

It was at first thought that a 500-kw. transformer had blown out, but Manager Farrand said it was impossible to say definitely what caused the trouble. The cables rendered useless were in a pit beneath a big switchboard. The transformer is of the oil-cooled type and a sudden flash of electricity ignited and spattered the oil.

An idea of the intensity of the heat in the cable pit is gained from conditions found after the fire. The three-ply copper cables were bound by steel tape, which was encased in a lead-pipe covering and in turn covered with asbestos. The heat had melted the lead covering and so affected the cables as to make them resemble, in the words of Manager Farrand, "a bunch of spaghetti."

## Burst Flywheel

At 2:30 a.m., June 11, a 15-ton flywheel of the stationary engine in the Delaware & Hudson Ry. shops, Green Island, N. Y., burst, but luckily no one was injured. The wheel was 14 ft. in diameter, with a 36-in. face. During the day 500 men are employed about the shops, but at the time of the accident only the engineer and his two assistants were on watch.

From some unknown cause the main belt of the engine broke and wound around one of the pipes running across the engine room, pulling the pipe down and breaking the flywheel in several places. Large pieces of the wheel went through the building, landing several hundred feet away. One piece went through the roof and another tore up several feet of railroad track.

This is the first accident to occur in these shops. The company immediately had a new wheel made and fitted. The damage was $1000.

## Increased Power at Rossland, B. C.

Anticipating the electrification of the Canadian Pacific Ry. from Castlegar to Rossland, B. C., the direction of the West Kootenay Power & Light Co. will increase the capacity of the No. 2 plant at Bonnington Falls. This plant has two units of 6600 hp. each, to which an 8000-hp. unit will be added, making 21,200 hp. available. When the plant was built space was allowed for two additional units.

With the increased power all of the trains on the Columbia & Western branch of the Canadian Pacific Ry. can be handled with power to spare. Before the road can be electrically operated, poles for the trolley wires will have to be erected. Presumably, the road will use the overhead rather than the third-rail system. The latter, besides being a menace to life, would hardly work advantageously where there is so much snow. It will be several months before this section of the road is ready for operation.

In 1911 America produced 83,000,000 barrels of petroleum.

## Europe Interested in Panama Exposition

John Hays Hammond, chairman of the American commission which went abroad to arouse the interest of European nations in the Panama-Pacific Exposition at San Francisco in 1915, has returned much pleased with the result of his trip.

"I was especially pleased with our reception in Russia," he said. "For a time I thought our efforts there would not equal our success in southern Europe on account of the slight friction between the two countries. Now Russia is in line with the rest and will be represented at the exposition.

"All of the European nations have already made preparations for representation, and we had no trouble in interesting them."

## Increased Use of Water Power

Of the 30,000,000 hp. used in industrial and public-utility enterprises, reports the Commissioner of Corporations, 6,000,000 hp. is now developed by water. At a conservative estimate, this saves 33,000,000 tons of coal per year. Several million more horsepower could profitably be developed from the same inexhaustible source.

Of the 6,000,000 hp. now developed, 3,270,755 is generated for sale (that is, not for private use, as in manufacturing) by companies or groups of interests having 50,000 hp. or more actually developed or under construction. The report concludes that it is not feasible to regulate the price of water power by itself, but rather to control the sites, or their uses.

# SOCIETY NOTES

The International Association of Municipal Electricians will hold its annual convention at Peoria, Ill., on Aug. 26 to 30.

The annual meeting of the Institute of Operating Engineers will be held at the Engineering Societies Building, New York, Sept. 6 and 7. Details will be announced as the program takes more definite form.

The June bulletin of the Institute of Operating Engineers announces that the second annual meeting will be on Sept. 6 and 7. At the July 2 meeting, William A. T. Willink, master operating engineer, will read a paper on "Efficiency in Steam Boiler Furnaces."

The sixteenth annual convention of the Connecticut State Association of the National Association of Stationary Engineers will be held in Bridgeport, June 28 and 29. The committee is hard at work making final arrangements. The mechanical exhibit will be the largest the state has yet seen and there will be an unusually big attendance of delegates. A good program of entertainment has been completed.

At the June 20 meeting of the American Society of Engineer Draftsmen in the Engineering Societies Building, New York City, William B. Harsel, the vice-president, will read a paper on "Sheet Metal Industris." Prof. William Noyes, of the Teachers College, Columbia University, will lecture on "American Woods for Commercial Purposes," illustrated by the stereopticon. The public is invited to attend.

# SCHOOL NOTES

The dinner commemorating the twenty-fifth anniversary of the founding of Pratt Institute, held in the Twenty-third Regiment Armory, Brooklyn, N. Y., June 15, was attended by about 1800 graduates and former and present students.

Prof. Levi L. Conant, for the last year acting president of the Worcester Polytechnic Institute, will continue in that capacity the coming year. Prof. Z. W. Coombs, acting secretary since the death of Secretary J. K. Marshall, three years ago, has been appointed permanent secretary by the trustees. John Harland Nelson, formerly head of the department of applied mechanics, of the Case School of Applied Science, in Cleveland, will occupy a similar position here next year. Prof. H. C. Ives, formerly assistant professor of railroad engineering, has been advanced to a professorship.

# PERSONAL

Nathan Owitz, of New York City, has been made manager of the Wheeler Condenser & Engineering Co.'s Cincinnati office.

S. R. Guggenheim has been chosen a director of the International Pump Co. in place of Benjamin Guggenheim, who was lost on the "Titanic."

Charles A. Moore, president of Manning, Maxwell & Moore, Inc., recently returned from Europe after an absence of nearly two years. Mr. Moore is in excellent health and is resuming his attention to business.

George F. Murphy has been appointed Eastern sales representative of the Busch-Sulzer Bros. Diesel Engine Co., of St. Louis, to succeed W. R. Haynie, with offices at 30 Church St., New York City.

Joseph V. Woodworth, consulting engineer at the New York office of the Taft-Peirce Manufacturing Co., Woonsocket, R. I., resigned recently to accept a similar position with the Boston Pressed Metal Co., Worcester, Mass., with offices in the Tribune Building, 154 Nassau St., New York City.

Joseph H. McNeil, chief inspector of boilers and chairman of the Board of Boiler Rules of the State of Massachusetts, has tendered his resignation, to take effect June 30, when he will become chief inspector of the Boston department of the Hartford Steam Boiler Inspection & Insurance Co.

Mr. McNeil has had a wide and valuable experience as an engineer and inspector. He was born, February, 1865, at Charlottetown, Prince Edward's Island, where he was educated in the public schools and Prince of Wales College. He served six years in the mechanical and executive department of the Prince Edward Island Ry. machine and boiler shop. After several years of stationary-engineering practice, he entered the merchant-marine service, where he became a chief engineer of ocean-going vessels, under license by the United States Government and the British Board of Trade.

In June, 1898, he was appointed an inspector of boilers and examiner of engineers for Massachusetts. In a reorganization of the boiler department in 1906 he took the civil-service examination and, ranking the highest, was appointed chief inspector of the department. Mr. McNeil's training was such that he saw great possibilities in an improved method of treating state supervision of boilers, and became a strong supporter, if not the very father, of the laws of 1907 which created the Board of Boiler Rules.

When the law was passed and the rules formulated, they were so much in advance of other legislation and supervision that they created some opposition among owners and boiler builders, but the administration of the rules has been so fairly and justly performed with Mr. McNeil as the chief executive that they are now looked upon as being equitable by the different interests of the state in every way and are being adopted with but few changes by other states and in one city even as far away as Manila, Luzon Island. Mr. McNeil is a member of a number of engineering societies, including the American Society of Mechanical Engineers.

# BOOKS RECEIVED

PRACTICAL AERONAUTICS. By Chas. B. Hayward. American School of Correspondence, Chicago, Ill. Cloth, 769 pages, 6¼x9½ in.; fully illustrated; indexed.

AERIAL OR WIRE ROPE WAYS. By A. J. Wallis-Tayler. D. Van Nostrand Co., New York. Cloth, 246 pages, 6¼x8½ in.; 155 illustrations; indexed. Price, $3.

AN INTRODUCTION TO THE STUDY OF FUEL. By F. J. Brislee. D. Van Nostrand Co., New York. Cloth, 269 pages, 5½x8¾ in.; 61 illustrations; indexed. Price, $3.

PRACTICAL MATHEMATICS AND GEOMETRY FOR TECHNICAL STUDENTS. Part II—Advanced Course. By Edward L. Bates and Frederick Charlesworth. D. Van Nostrand Co., New York. Cloth, 776 pages, 4¾x7¼ in.; 300 illustrations; indexed. Price, $1.50.

# Moments with the Ad. Editor

You remember the story of the German who was scared half to death because he was being followed by a loudly barking bull dog—

A friend stopped him and said, "Don't be afraid, Heine; when a dog is wagging his tail like that one, he won't bite you. Don't you know that?"

And Heine tremblingly replied, "Sure, *I* know it, but does the *dog* know it?"

You see there are cases where a complete understanding is absolutely necessary—and that's the reason for these little talks on advertising.

It has become highly important for every man of influence in this country to understand something about advertising—

And that applies to all you men who are responsible for that most fundamental element of modern industry—the generation and transmission of power.

Here's one way to look at it:

Supposing a manufacturer today put out a device for use in power plants. Supposing it was bad in principle, design and construction and wouldn't do the work he claimed for it. Supposing he wanted to advertise it in "Power" and sell it to you readers of the paper—

What would happen?

Well, in the first place "Power" wouldn't print his ad at any price—nor would any other reputable paper.

In the second place if he *could* get an ad before you, the chances are 100 to 1 that you would see the flaws in his illustrations and claims and laugh at him.

Or you would make him show you his product and prove its merit before you'd buy it.

But even if he did succeed in selling some of his appliances and they failed to do the work, then the ones who had been "stung" would advertise the fact broadcast and the manufacturer would go to the wall.

That's just about the chance a fake manufacturer would have in these days of modern advertising—

And it gives you an idea of the great *protective* value of advertising.

The advertiser of today makes his space pay him by making it pay you to buy his article—and that's the only way in the world any advertising can be made to pay.

Which is the chief reason why it will pay you to read the ads in "Power" and buy the goods advertised.

## Panama Pacific Exposition

President Charles C. Moore, of the Panama-Pacific International Exposition, has advised the Department of Commerce and Labor that the directors have fixed Feb. 20, 1915, as the opening day. The mildness of California winters enables this world's fair at San Francisco to arrange for "its continuance from winter to winter, which will be of the utmost advantage to participating nations, states and individuals."

# NEW EQUIPMENT

### ATLANTIC COAST STATES

The Julius Kayser Co., Amsterdam, N.Y., contemplates the construction of an addition to its power plant.

The plant of the Perry Electric Light Co., Perry, N. Y., was destroyed by fire on June 14. It will be rebuilt at once. Estimated loss, $50,000.

Bids will be received by the Peoples Light, Heat & Power Co., until July 1, for the reconstruction of its substation at Mahanoy City, Penn. The Scofield Engineering Co., Philadelphia, Penn., is consulting engineer.

Bids will be received by the Water committee, Westernport, Md., until July 2, for the construction of a water-works system. C. H. Bruce is city clerk.

### SOUTHERN STATES

Bids will be received by the Town Commissioners, Carthage, N. C., until 2 p. m., July 16, for the construction of a water-works system. W. G. Jennings is secretary of the commission.

Cartersville, Ga., has voted bonds to the amount of $50,000 for improving the municipal electric-light plant. J. E. Wikle is superintendent of the plant.

The construction of an electric-light plant at Hastings, Fla., is contemplated.

Athens, Ala., has voted a bond issue of $12,000 for the construction of an electric-light and water plant.

The citizens of Franklin, La., are considering the extension and improvement of the municipal electric-light plant.

A franchise has been granted to H. W. Wright, of Winnfield, La., to construct and operate an electric-light plant and water-works system at Jena, La.

W. W. M. Worley, of Vaughtsville, Tenn., contemplates the construction of an electric-light plant at Mountain City, Tenn.

The construction of an electric-light plant at Burkesville, Ky., is contemplated by C. R. Payne.

### CENTRAL STATES

Plans are being prepared by I. A. Amsden, city engineer, Ashtabula, Ohio, for extensions and improvements to the municipal electric-light plant.

The installation of an engine and generator in the municipal electric-light plant at Mitchell, Ind., is under consideration.

Preliminary plans have been prepared for the construction of a water-works system at Newaygo, Mich. Estimated cost, $15,000. N. Brown is city clerk.

The construction of an electric-light plant at Pinconning, Mich., is contemplated by C. H. Arnold.

Bonds to the amount of $20,000 have been voted for the construction of a water-works system, at Stockbridge, Mich.

A franchise has been granted to the Piasa Power & Light Co. to construct and operate an electric-light plant at Alton, Ill.

### WEST OF THE MISSISSIPPI

The plant of the What Cheer Electric Co., What Cheer, Iowa, has been purchased by F. A. Heilman. The new owner contemplates the installation of new machinery throughout the plant.

Bonds to the amount of $9,000 have been voted for the improvement of the municipal electric-light plant and water-works system, at Long Prairie, Minn.

Plans are being prepared by the Oscar Claussen Engineering Co., St. Paul, Minn., for the construction of a municipal electric-light plant at North St. Paul, Minn.

The citizens of Axtell, Kan., have voted bonds to the amount of $10,000 for the installation of an electric-light system.

The citizens of Homer, Neb., are considering the construction of a water-works system at a cost of $10,000. James Blanchard is village clark.

The construction of an electric-light plant at Highmore, S. D., is under consideration.

Bids will be received until June 25, for the construction of a water-works system at Beach, N. D. Estimated cost, $25,000. M. A. Egan is city auditor.

The citizens of Buffalo Springs, N. D., contemplate the construction of an electric-light plant.

The construction of an electric-light system at Cutbank, Mont., is contemplated by W. O. Scott, and associates.

The citizens of Bethany, Mo., have voted to conconstruct a water-works system at a cost of $25,000. J. B. McClure is city clerk.

Plans have been prepared for the construction of a water-works system at Hermann, Mo. Estimated cost, $35,000.

The construction of a substation on Page Boulevard, St. Louis, Mo., is contemplated by the Mississippi River Power Distributing Co. C. S. Ruffner is manager of the company.

Plans are being prepared for the construction of a water-works system at College Station, Tex.

The city council of Coleman, Tex., is taking steps toward the construction of a municipal electric-light and power plant.

Madisonville, Tex., contemplates a bond issue of $20,000 for the construction of a municipal electric-light and water-works system.

The construction of an electric-light plant and ice factory at Sanderson, Tex., is contemplated by Edward McGinley.

It is reported that bids will be received until June 24, for the construction of a water-works system at Kenefik, Okla. Estimated cost, $13,000.

The installation of a water-works system at Oak Creek, Okla., to cost $30,000, is contemplated. P. D. Shepperd is interested.

The installation of a power plant in the State Agricultural College at Las Cruces, N. M., is under consideration.

Bonds to the amount of $85,000 have been voted for the construction of a water-works system at Burley, Idaho.

The citizens of Hopkins, Utah, are considering the installation of an electric-light system.

Mt. Pleasant, Utah, contemplates the purchase of the plant of the Mt. Pleasant Mill & Power Co. The city plans to enlarge the plant and make other improvements.

The Lehi Irrigation Co. contemplates the construction of a pumping station in the Jordan Narrows, Lehi, Utah.

The Union Mining & Power Co. contemplates the construction of power plants on its property at Clearcreek, Calif. Thomas Gilbert and Duncan McRae of Chico, Calif., are interested.

The installation of a power plant in the new Children's Hospital at Vernon Ave. and Sunset Boulevard, Los Angeles, Calif., is included in the plans by Hunt & Burns, Laughlin Building, Los Angeles.

B. C. Clark, Redlands, Calif., contemplates the installation of a pumping plant and water system on his ranch at San Jacinto, Calif.

Medicine Hat, Alta., contemplates an expenditure of $60,000 for improvements and extensions to the municipal electric-light plant. H. Baker is city clerk.

B. W. Dudley, First National Bank Building, Cincinnati, Ohio, is receiving bids for the construction of a power plant to be erected in connection with the establishment of the Indian Refining Co., at Tampico, Mex.

Outlook, Sask., has voted an appropriation of $15,000 for the installation of an electric system.

# BUSINESS ITEMS

At a meeting of the directors of the Watson Stillman Company, 50 Church street, New York, May 15, the following officers were chosen: President, E. A. Stillman; vice-president and secretary, A. F. Stillman; treasurer, J. P. Bird; chief engineer, Carl Wigtel; superintendent, Frank Lary.

The Winnipeg branch of the H. W. Johns-Manville Company, owing to its fast increasing business, has found it necessary to move into new quarters at 92 Arthur St. This is a six-story and basement building, 100 feet deep and 50 feet wide, and will be occupied throughout by the company's offices and storerooms. By reason ofthis move, a much larger and more complete stock of goods will be carried on hand than heretofore, and a larger force will be employed to look after the company's interests.

The announcement is made, dated as from June 1, 1912, that the three associated companies, the Alberger Condenser Co., Alberger Pump Co. and the Newburg Ice Machine & Engine Co. will in future be known as the Alberger Pump & Condenser Co. The officers of the new company are George Q. Palmer, president, William S. Doran and D. H. Chester, vice-presidents, and William R. Billings, sceretary-treasurer. The main offices are at 140 Cedar street, New York. The large amount of condenser and centrifugal pump orders in hand has demanded important additions to the plant and equipment of the company's works at Newburg, N. Y. Important orders are being executed for the U. S. Navy Department, Isthmian Canal Commission, U. S. War Department, American Gas & Electric Co., Public Service Corporation of New Jersey, Cleveland Illuminating Co., the Robin's Dry Dock & Repair Co. and others of the largest corporations in this country and its dependencies. The line of apparatus manufactured by the Alberger Pump & Condenser Co. consists of surface, jet and barometric condensers of various designs, cooling towers, a complete line of volute and turbine type centrifugal pumps, steam turbines, feed water heaters, hot water service heaters and expansion joints.

# NEW CATALOGS

J. E. Rhoads & Sons, Philadelphia, Penn. Catalog, leather belting. Illustrated, 76 pages, 5x7 in.

Lunkenheimer Co., Cincinnati, Ohio. General catalog, engineering specialties. Illustrated, 654 pages, 5x7¼ in.

A. L. Ide & Sons, Springfield, Ill. Bulletin No. 20, Ideal Corliss valve engine. Illustrated, 12 pages, 8½x11 in.

Kerr Turbine Co., Wellsville, N. Y. Bulletin No. 24, Economy steam turbine for belt drive. Illustrated, 4 pages, 6x9 in.

Greene, Tweed & Co., 109 Duane street, New York. Catalog, latest improved Rochester automatic lubricator. Illustrated, 48 pages, 7x10 in.

Auld Co., 1229 North Twelfth St., Philadelphia, Pa. Catalog 8, Section R, "Quitetite" reducing valve. Illustrated, 12 pages, 8x11 in.

American District Steam Co., North Tonawanda N. Y. Booklet G., atmospheric system of steam heating. Illustrated, 16 pages, 3½x6 in.

Hess-Bright Manufacturing Co., 21st St. and Fairmount Ave., Philadelphia, Pa. Catalog, ball bearing hangers. Illustrated, 32 pages, 6x9 in.

Hoskins Manufacturing Co., 453 Lawton Avenue, Detroit, Mich. Bulletin No. 10. Type F. C. Muffle Chamber electric furnaces. Illustrated, 16 pages, 6x9 in.

Pratt & Cady Co., Hartford, Conn. Four circulars. Boiler stop, swing check, globe, radiator, angle valves and asbestos-packed cocks. Illustrated, 4 pages each. 6x9 in.

# You can Quickly Tell whether the Steam Gauges are Wrong or Not

**By testing them with an American Dead Weight Gauge Tester. The illustration shows you how simple this device is—nothing to study before you can use it—nothing to get out of order—as simple as any weighing scales.**

Attach the gauge—put on the dead weights and watch the figures. A glance shows whether the gauge is registering correctly or how far it is wrong.

It's a simple device that guards against loss of coal due to gauge inaccuracy.

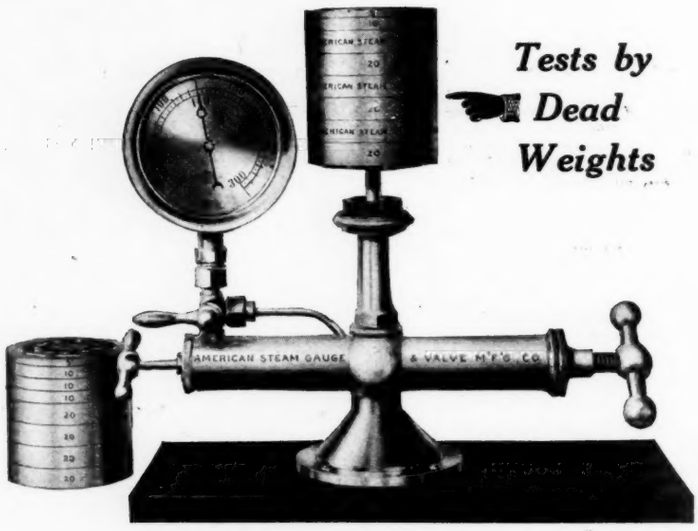
As soon as the gauges lose their accuracy, they mislead the fireman, cause fuel waste, reduce engine efficiency.

And gauges will go wrong through neglect, or carelessness, or abuse.

Keep them accurate by means of an American Dead Weight Gauge Tester.

This tester is the simplest and most compact device of its kind, more reliable than the test gauge, needs no continual repairing, has all the advantages of the mercury column.

It's a practical coal saving device that it will pay you to install.




*Tests by Dead Weights*

## Write For Pocket Edition Catalog

We will send you a copy of this handy book for your own use. The coupon starts it in your direction ***at once.***

The Pocket Edition of the American Catalog is worth sending for immediately. We'll expect to hear from you.

SIGN AND MAIL COUPON

American Steam Gauge & Valve Mfg. Co.
Boston, Mass. 6-25-12

Send me your Pocket Edition Catalog

Name. . . . . .

Address. . . . . .

**American Steam Gauge & Valve Mfg. Co.**
**Boston, Mass.**

**Sales Offices in New York, Chicago, San Francisco, Pittsburg, Atlanta, Montreal**

THE BEST HOUSES EVERYWHERE SELL OUR PRODUCTS

# Keep Your Eyes on the Job Ahead You Can Get There

## But don't forget that to win promotion you must first be thoroughly efficient in your present job.

You yourself, if you were an employer, wouldn't promote a man who wasn't "making good."

And your employer is just the same in this respect.

Put your best efforts into your work, show the boss that you are saving money for him, and promotion will come easily.

To do this, you should own an accurate indicator, an American-Thompson, and use it frequently.

With the aid of this instrument you can know instead of guess what is happening inside the cylinder.

You can keep the valves properly adjusted, prevent leaks in the valves or piston, save coal, save wear and tear of the engine, reduce engine repairs.

You can, in other words, do your work as it should be done—at the least cost for fuel and repairs.

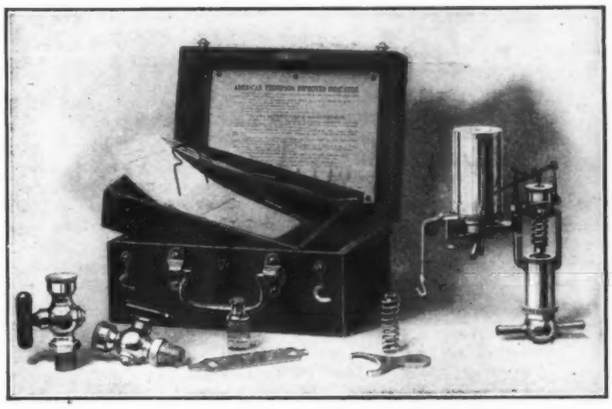
Then you can keep your eyes on the job ahead, knowing that you will be found "fit" when your opportunity comes.

But when buying an indicator be sure that you buy an indicator that is absolutely accurate, for misleading diagrams will only get you into trouble.

## $5.00 Down $5.00 Monthly

The price of the outfit as shown is $55.00, with reducing wheel $65.00. The cost of the detent motion is $15.00. The terms are easy—made easy to put this standard instrument within your immediate reach—$5.00 down and $5.00 per month.

Send $5.00 and two good references today; we will ship outfit at once and its yours for examination for 5 days. Don't put this matter off any longer—take this opportunity now—you'll be the gainer.



The American-Thompson is the original Thompson Indicator.

It is the most imitated instrument on the the market.

To be absolutely sure of getting the right indicator, ask for the "American-Thompson Indicator made by The American Steam Gauge and Valve Mfg. Co."

Always specify it in that way.

**American Steam Gauge & Valve Mfg. Co.**
**Boston, Mass.**

Sales Offices in New York, Chicago, San Francisco, Pittsburg, Atlanta, Montreal

THE BEST HOUSES EVERYWHERE SELL OUR PRODUCTS

SIGN AND MAIL COUPON

American Steam Gauge & Valve Mfg. Co.
Boston, Mass.

Send me full details of offer No. 167

Name . . . . . .

Address . . . . . .

## Engineers Wanted

Under this head are published, without charge, advertisements of actual vacancies in power plants for operating engineers and assistant engineers. For the guidance of applicants for advertised positions, the advertisements must contain particulars to show the class of service demanded and the wages paid. Employers who desire to advertise under this head are requested to write for a blank form of application.

## HELP WANTED

Advertisements under this head are inserted for 25 cents per line. About seven words make a line.

UNUSUAL OPPORTUNITY with option of investment for mechanical engineer, combining engineering knowledge with some executive and selling ability. Company located in Buffalo, N. Y., manufacturing and selling contractors' machinery and equipment, also specialties for steam, water, gas, oil and air. Box 685, Power.

SALESMAN—Thoroughly competent steam specialty salesman; one that can sell high-grade goods. Address "M. M. Co.," Power.

STOKER ERECTORS, first class; none but experienced men need apply; state age, salary wanted, habits and references. Box 668, Power.

SALES AGENTS to sell Goetze Metallic Packings of good reputation. Write us. Goetze Gasket & Packing Co., New Brunswick, N. J.

AGENTS selling to steam plants can make big money selling for us; no samples; no experience is necessary. Armstrong Mfg. Co., Springfield, Ohio.

THE VULCAN SOOT CLEANER offers an exceptional opportunity for power specialty salesman. Address G. L. Simonds & Co., 802 Steinway Bldg., Chicago, Ill.

AGENTS WANTED to sell forced draft blowers and damper regulators; will give exclusive territory to right parties; commission on sales. Turbo-Blower Co., 30 Church St., New York.

MANUFACTURERS' AGENTS to handle thoroughly guaranteed steam specialties; feed water heaters, steam and oil separators, traps and exhaust pipe heads; not necessary to represent entire line if interested in only part of it; our specialties are well advertised and of good reputation. Box 569, Power.

MINE ELECTRICIAN for W. Va. coal camps, must have had practical experience, repairing mine locomotives and generators in coal camps. Ten locomotives, five generators, five motors, five mining machines. Give age, experience, where obtained, in what capacity, education and where obtained, married or single, salary expected. Only sober, practical men willing to live in coal camp need apply. Address 680, Power.

## Situations Wanted

Advertisements under this head are inserted for 25 cents per line. About seven words make a line.

TECHNICAL GRADUATE, two years' practical experience, desires position as efficiency man or along similar line. Box 684, Power.

DESIGNING POWER PLANTS, "Who can use a man capable of designing power plants and electric systems from their smallest detail up. Ten years' experience operating, erecting, drafting." Box 686, Power.

CHIEF ENGINEER—Open for engagement; electric light and railway power stations, factory and institution steam plants; 40 years of age; well educated and good reputation. Box 682, Power.

CHIEF ENGINEER, 15 years' experience, runs large railway and lighting station, also isolated plants, experience both reciprocating engines and turbines, knows combustion and fuel economy, wants plant within 20 to 30 miles New York City. Box 677, Power.

CHIEF ENGINEER or Master Mechanic. Age 38, with 20 years of broad practical experience installing and operating large gas, steam and electric power plants. Has 1st Class Mass. License and references as to character and ability. Box 681, Power.

## MISCELLANEOUS

Advertisements under this head are inserted for 25 cents per line. About seven words make a line.

PATENTS SECURED—C. L. Parker, Patents, 904 G St., Washington, D. C.

BACK COPIES POWER, sets, volumes before 1908 wanted for cash by International Magazine Co., Elizabeth, N. J.

EVERY ENGINEER should be posted regarding the new system of vacuum heating installed without payment of royalty; I have valuable information; write today. M. Y. C., 1417 W. Jackson Blvd., Chicago, Ill.

CENTRAL LIGHTING SYSTEM, Good chance in Town of 1000 population; two lines R. R.; two towns each 500 population, each seven miles away; free building site on right of way; taxes remitted for ten years; long time franchise; Town now paying nearly $1,000 for upkeep of gas light, and will give a liberal street lighting contract; part of capital can be raised here. Anyone interested write **A. C. Jarvis, Humeston, Ia.**

## FOR SALE

Advertisements under this head are inserted for 25 cents per line. About seven words make a line.

FRANKLIN WATER TUBE BOILER, 182 hp., used three weeks. Franklin Boiler Works Co., Troy, N. Y.

100 HP. SCOTCH MARINE BOILER, 18 months old, 125 lbs. Hartford insurance, butt-strapped, triple riveted, $500 f.o.b. Sunbury, Ohio. Duzets & Son, 50 Church St., N. Y.

350 KW. WESTINGHOUSE direct current generator, 250 volts, direct connected to 24x36 heavy duty Corliss engine; unit complete with switchboard, balancing set, etc. Arthur S. Partridge, 417 Pine St., St. Louis.

CORLISS ENGINES: 5000 hp. Allis vertical cross compound Corliss; 1200 hp. Hamilton horizontal cross compound Corliss; 750 hp. Filer & Stowell cross compound horizontal heavy duty with condenser. Arthur S. Partridge, 417 Pine St., St. Louis.

CORLISS ENGINES—20x40x48, 30x60, 16x32x48, 24x42, 20x42, 16x36, 14x36, 10x11 Chuse, 9x14 Straight Line, 9x12 Russell; Horizontal and Fire Box Boilers, heaters, pumps, compressors, etc. John Ramming Machine Co., Main St. & Clark Av., St. Louis, Mo.

1-225 H.P. NORDBERG Cross Compound Condensing Corliss Engine, 12x22x36; 14 ft. rope pulley; 10 grooves 1¼" rope; 1-125 K.W. 2 phase, 60 cycle, 2200 volt Westinghouse generator, with exciter, and switchboard panel; the unit is immediately available as being taken out to make room for a 1000 K.W. steam turbine. For further particulars address, Board of Public Works, Holland, Mich.

500 HORSEPOWER right-hand engine; simple Corliss heavy duty frame, size, 24x48, complete, including flywheel, 18 ft. diameter, grooved for 14 turns 1¼-in. rope, American drive-steam receiver separator, 7-in. steam pipe including one long radius bend and flanges; can be seen in operation at our mill in Mt. Carmel, Ill. Address Bernet Craft & Kauffman Mlg. Co., Office 1036 Pierce Building, St. Louis, Mo.

ONE 500-HORSEPOWER HOPPES live steam purifier; one 35 kilowatt General Electric, 230 volt steam turbine and dynamo and switchboard panel; one complete Emerson steam pump, including working barrel, capacity 200 gallons per minute; two Worthington water meters; one iron tank, 60,000 tensile strength, 42" diam. and 9' high; two Bundy traps No. 100 and No. 52 series; two Anderson traps No. 3 and No. 2. All in A-1 condition; will sell cheap. Box 656, Power.

ONE HEWES & PHILLIPS Corliss engine, 14x36 in., in excellent condition; flywheel, 10 feet diameter, 18 in. face, five to six years old. One 75-kw. a.c. Westinghouse generator, 3 phase, 220 volts, 60 cycles, 900 r.p.m. with switchboard and exciter complete. One 50-kw. a.c. Westinghouse generator, 3 phase. 220 volts, 60 cycles, 1200 r.p.m. with switchboard and exciter complete. One 45-kw. d.c. General Electric generator, 115 volts, 850 r.p.m., with switchboard complete. The Salt's Textile Mfg. Co., Bridgeport, Conn.

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# At least 50% Reduction in Maintenance Cost of Fire Walls and Arches

The maintenance cost of your fire walls and arches is at least 50% higher than it should be if you are setting up your fire-brick with fire-clay and like materials—because high temperatures cause such materials to fuse and run, necessitating frequent repairs and endangering the entire structure. You can cut down this expense by using

## J-M High Temperature Cements

These cements, being made of Asbestos, and other refractory materials, resist temperatures up to 3,000 degrees Fahr., which is a far greater heat than fire-clay can withstand. They make a permanent bond that increases in strength when vitrified.

Tests in actual service have proven that J-M High Temperature Cements last several times as long as fire-clay and like materials when used to set up fire-brick in boiler furnaces, etc.

Write our nearest House for booklet, stating nature of your trouble, class of furnace and temperature.

## H. W. JOHNS-MANVILLE CO.

Manufacturers of Asbestos and Magnesia Products — ASBESTOS — Asbestos Roofings, Packings, Electrical Supplies, Etc.

Albany, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Indianapolis, Kansas City, Los Angeles, Louisville, Milwaukee, Minneapolis, New Orleans, New York, Omaha, Philadelphia, Pittsburgh, San Francisco, Seattle, St. Louis, Syracuse

For Canada:—THE CANADIAN H. W. JOHNS-MANVILLE CO., LIMITED.
Toronto, Ont. Montreal, Que. Winnipeg, Man. Vancouver, B. C.

(1692)



# NELSON Bronze Gate Valves

TRADE-MARK REGISTERED

*Send your order direct to us if your jobber hasn't complete stock.*

*We will take care of you*

Nut screwed on, *not riveted*, can easily remove wheel to renew packing.

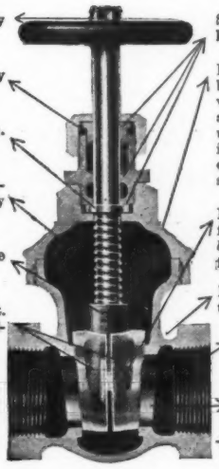
Gland on Medium and Extra Heavy valves.

Stem collar cast solidly on the stem. Collar is *always* there.

Threads. Scientifically and mechanically correct, strong, wear well, easy to operate.

Wedge. The only spreading device in the valve. *One piece.* Simple.

Discs. Two. Simple. Compact. Can't get out of order. Automatically rock into perfect alignment with the seats, not only when the seats are new, but should the seats become distorted from their original angle, through sagging of the pipe or otherwise, the discs will still *make up tight* with the seats.



Stem has bearing at *three* points, keeping the stem central and steady.

Bonnet. Screwed on outside of body on Medium and Extra Heavy valves, strengthening it for severe service. The outside bonnet is not used on Standard valves, as the body is made so strongly that it is not required for 125 pounds working pressure.

Disc Guides. These guide the discs freely, making operation easy, *no binding at any point*, prevent discs from scraping on the seats.

Body. *Strong*, because well proportioned, well balanced, curved shape.

Threads. Cut *taper*, to standard gauges, for good, tight, pipe connection.

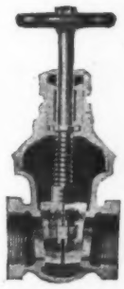
100% opening, *no obstructions.*

Hexagons unusually long and very heavy.

**NELSON**

*Valves are also made in the Globe and Check types, in all sizes, for any pressure, for any purpose*

Outside view of Standard Valve



Inside view of Standard Valve

Extra Heavy, for 300 pounds. Medium, for 175 pounds. Standard, for 125 pounds.

## Nelson Valve Company, Philadelphia

NEW YORK 30 Church St. — CHICAGO 17 West Kinzie St. — SAN FRANCISCO 22 Battery St. — PITTSBURGH 517 Liberty Ave.

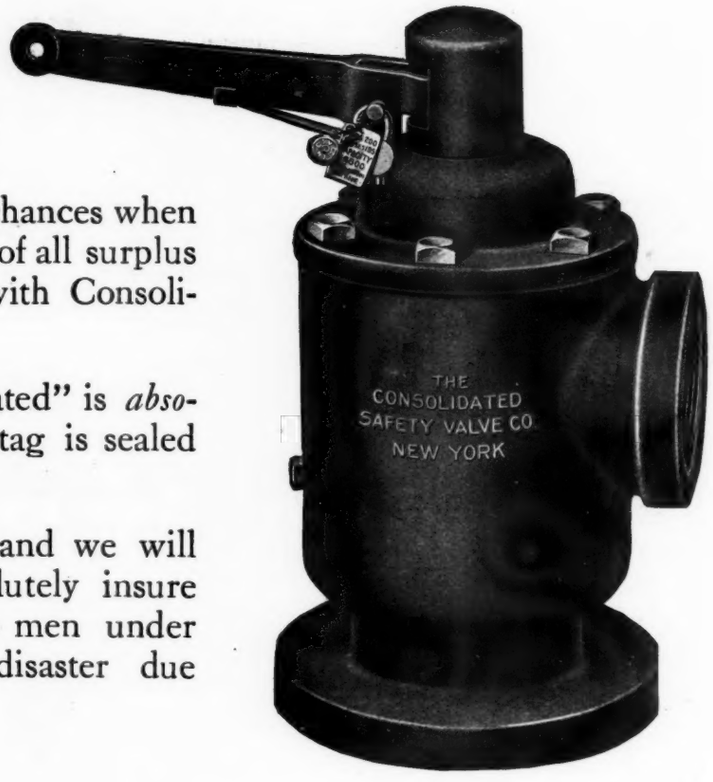
MINNEAPOLIS 622 Andrus Bldg. — BUTTE 56 E. Broadway — MONTREAL 12-14 University St.

TABOR INDICATOR | HANCOCK IMPROVED VALVE | THE BIG FOUR | CONSOLIDATED POP SAFETY VALVE | METROPOLITAN INJECTOR

# SAFETY!

Make sure that the boilers in your plant are guarded against over pressure by installing

## Consolidated Pop Safety Valves




Are you *sure* that the safety valves you are now using will take care of *all* the steam that may *some day* have to go through them—in event, for example, of a sudden break down? Why take chances when you can make sure of positive relief of all surplus steam by equipping your boiler with Consolidated Pop Safety Valves?

The capacity of every "Consolidated" is *absolutely guaranteed.* A guaranteed tag is sealed to the lock-up device.

Fill out the coupon, mail it and we will tell you how you can absolutely insure the plant and lives of the men under your charge against disaster due to overpressure.

**Consolidated Safety Valve Co.**

What "Consolidated" equipment will make my plant safe.

Name .....

Address .....

No. of boilers..... Type and make of boilers .....

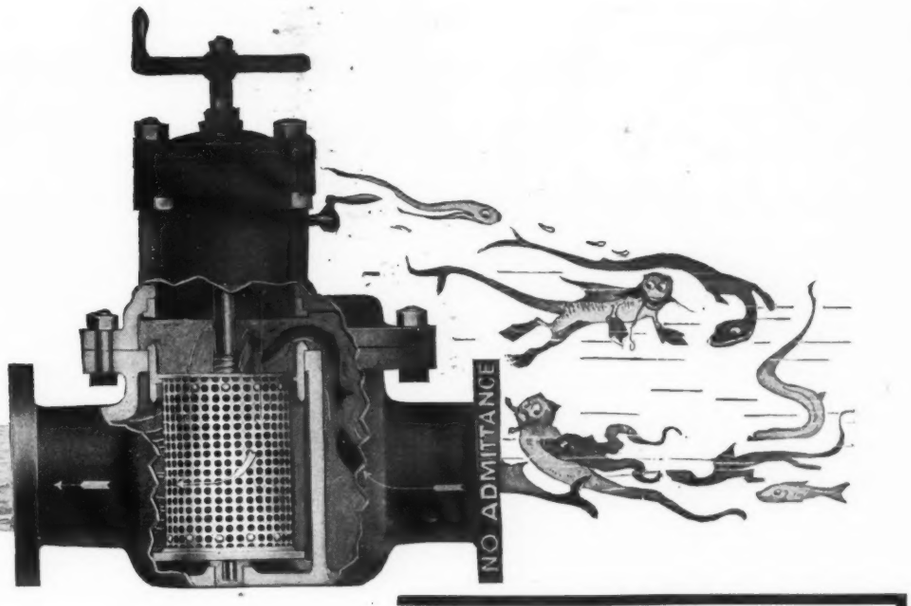
H.P. per boiler..... No. of safety valves now used.....

Their size..... Pressure at which set.....

## The Consolidated Safety Valve Co.

**85-89 Liberty St., New York;**
**111-115 No. Canal St.. Chicago**

**The Tabor Indicator—The Ashcroft Mfg. Co.; The Hancock Improved Valve—The Hancock Inspirator Co.; The Metropolitan Injector—The Hayden & Derby Mfg. Co. All—85-89 Liberty St., New York; 111-115 No. Canal St., Chicago.**




# Impurities Cannot Shoot Through This Strainer

Lagonda Multiple-Strainers have such a large Straining area that even with one straining basket out of service for cleaning, the velocity of the water is ½ to 1/6 of that in the pipe line. There is also a change in direction of flow.

We have thus entirely eliminated *direct flow* and *high velocity*, the two foes of efficient filtration and have allowed plenty of time for settling.

The Lagonda Multiple-Strainer is the only one designed on these scientific principles. It should be installed in all water intake lines as it is effective in removing fish, ice, sticks, leaves or other material which would clog condensers or pumps. It is suitable for use in suction or pressure lines, can be installed inside or outside of the building and can be cleaned while in service. There are numerous other points about the Lagonda Multiple-Strainer with which you should be familiar.

**Write for Catalog R and find out about them, or better yet, if you have ever had any interruption of circulating water, let us send you a Lagonda Multiple-Strainer on trial.**

## The Lagonda Mfg. Co.

SPRINGFIELD, OHIO.

FUEL SAVING SPECIALISTS

NEW YORK, BOSTON, PHILADELPHIA, PITTSBURG, CHICAGO, DETROIT, ST. LOUIS, SAN FRANCISCO, ST. PAUL, MONTREAL, LONDON.

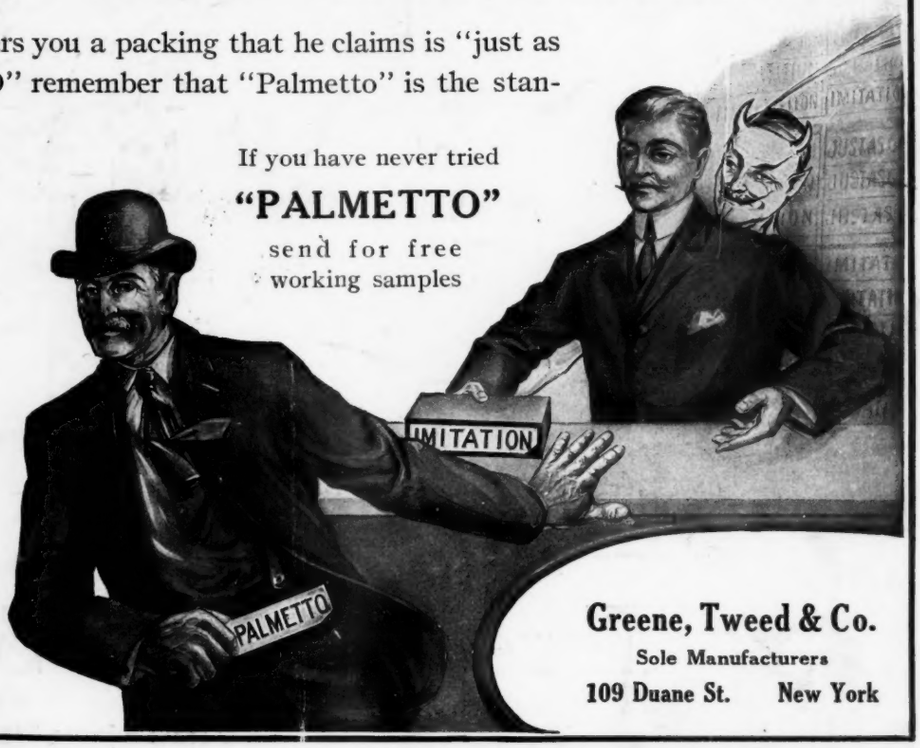
Makers of Weinland Boiler Tube Cleaners, Automatic Cut-off Valves, Reseating Machines, Boiler Tube Cutters and Water Strainers.

# The "Imitation Devil" Is About And He'll Get You, If You Don't Watch Out

When the dealer offers you a packing that he claims is "just as good" as "PALMETTO" remember that "Palmetto" is the standard he's working to, so stick to the standard, for you know that "Palmetto" is not only the highest quality in rod packings but it is always the same as the last you used.

Imitations are never uniform in quality.

They are only made to sell and not to develop future business.



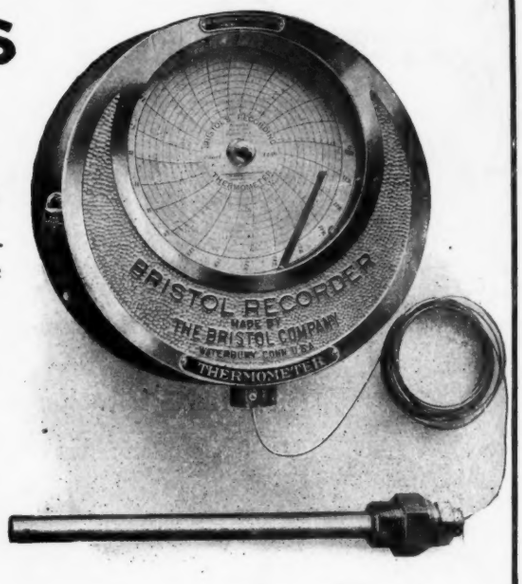

**Greene, Tweed & Co.**
Sole Manufacturers
109 Duane St. New York

---

TRADE MARK
# BRISTOL'S
REG. U. S. PAT. OFFICE.

## Recording Instruments

for pressure, temperature, electricity, speed and time constitute the most *extensive* as well as the *simplest* line of recording instruments in the world. You have only to say "BRISTOL" to get the most widely used and popular Recording Instruments in existence.




### Original Form Thermometer

Bristol's Class III Recording Thermometers are designed for ranges from 60° below zero to 800° F. Used extensively for temperatures of superheated steam, flue gas, condenser water, economizers, refrigeration apparatus, etc. Note the flexible steel—protected connection tube.

### The Round Form Model Is Cheaper

And it will give you good service—the only kind given by *any* Bristol Instrument. For unfailing, reliable and long continued service Bristol's Recording Thermometer is without equal. Uses 6-inch charts only. Write for Reference Book No. 160 and Bulletin No. 127.

**The Bristol Company, Waterbury, Conn., U.S.A.**

3878